BUREAU OF STANDARDS
NOV 14 1921

THE TECH ENGINEERING NEWS

OCTOBER 1921

Mountains of Oil
Dean Henry Paul Talbot
New Fisheries Engineering Course
The Exposition of Chemical Industries
Super-Power Zone Transformers
Undeveloped Sources of Energy
Tech Traditions
Monthly News

VOL. II NO. 4

Otis
The WORLD'S WORD for ELEVATOR SAFETY

Otis
The WORLD'S WORD for ELEVATOR SAFETY

THE STATUE OF LIBERTY

Most of the famous structures of the world are equipped with Otis Elevators.

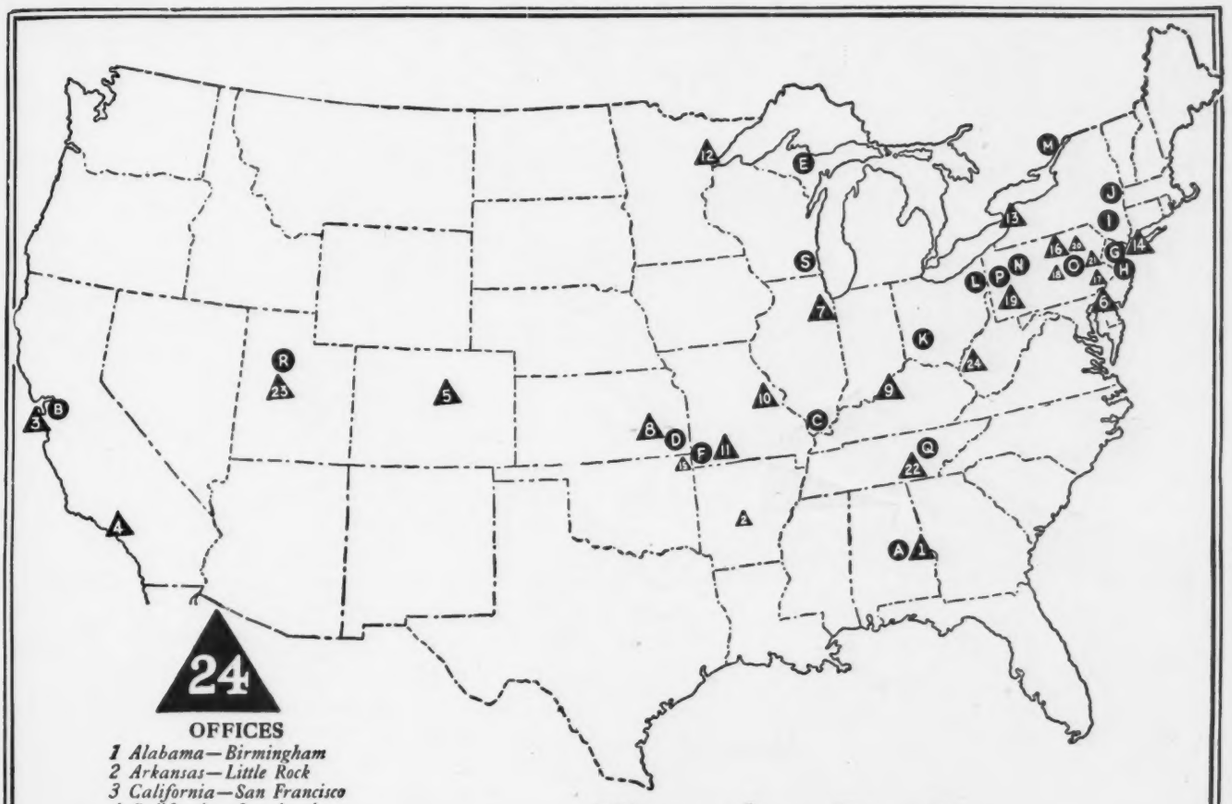
WHAT structure is better known or is more typical of America than this Statue at the gate of New York?

Countless thousands from the old world pass under the uplifted arm that holds a light which means to them worlds more than to us, though our millions know it and love it for the symbol it is.

It is fitting that an Otis Elevator should carry passengers up through the base to the foot of the Statue. For though the activities of Otis are world-wide, the beginnings, the creation, the basic ideas and the great developments of vertical transportation were made by Otis in America.

OTIS ELEVATOR COMPANY

Offices in all Principal Cities of the World



24

OFFICES

1 Alabama—Birmingham
2 Arkansas—Little Rock
3 California—San Francisco
4 California—Los Angeles
5 Colorado—Denver
6 Delaware—Wilmington
7 Illinois—Chicago
8 Kansas—Pittsburg
9 Kentucky—Louisville
10 Missouri—St. Louis
11 Missouri—Joplin
12 Minnesota—Duluth
13 New York—Buffalo
14 New York—New York City
15 Oklahoma—Commerce
16 Pennsylvania—Hazleton
17 Pennsylvania—Norristown
18 Pennsylvania—Pottsville
19 Pennsylvania—Pittsburgh
20 Pennsylvania—Wilkes-Barre
21 Pennsylvania—Allentown
22 Tennessee—Chattanooga
23 Utah—Salt Lake City
24 West Virginia—Huntington

19

PLANTS

A Alabama—Birmingham
B California—Hercules
C Illinois—Fayville
D Kansas—Turck
E Michigan—Ishpeming
F Missouri—Joplin
G New Jersey—Kenvil
H New Jersey—Parlin
I New York—Port Ewen
J New York—Schaghticoke
K Ohio—Goes
L Ohio—Youngstown
M Ontario—Prescott
N Pennsylvania—Emporium
O Pennsylvania—Ferndale
P Pennsylvania—Sinnamahoning
Q Tennessee—Marlow
R Utah—Bacchus
S Wisconsin—Pleasant Prairie

Hercules Service Strengthened

The acquisition of the business and properties of the Aetna Explosives Co., Inc., by the Hercules Powder Co., adds additional significance to the words *Hercules Service.*

There are now 19 plants manufacturing Hercules Explosives and Blasting Supplies, and 188 Hercules-owned main distributing magazines in addition to many dealers situated in all sections of the country, who own magazines and carry stocks of Hercules Products. The 24 Hercules Sales Offices are shown on the map above.

If you are interested in the elimination of waste in industry, put the Hercules Service Division to work on your blasting problems. It will cost you nothing and is apt to save you money.

By acquiring the business of the Aetna Company, we have assumed increased service obligations to the users of explosives all over the country and shall welcome any opportunity to demonstrate our readiness and ability to meet them.

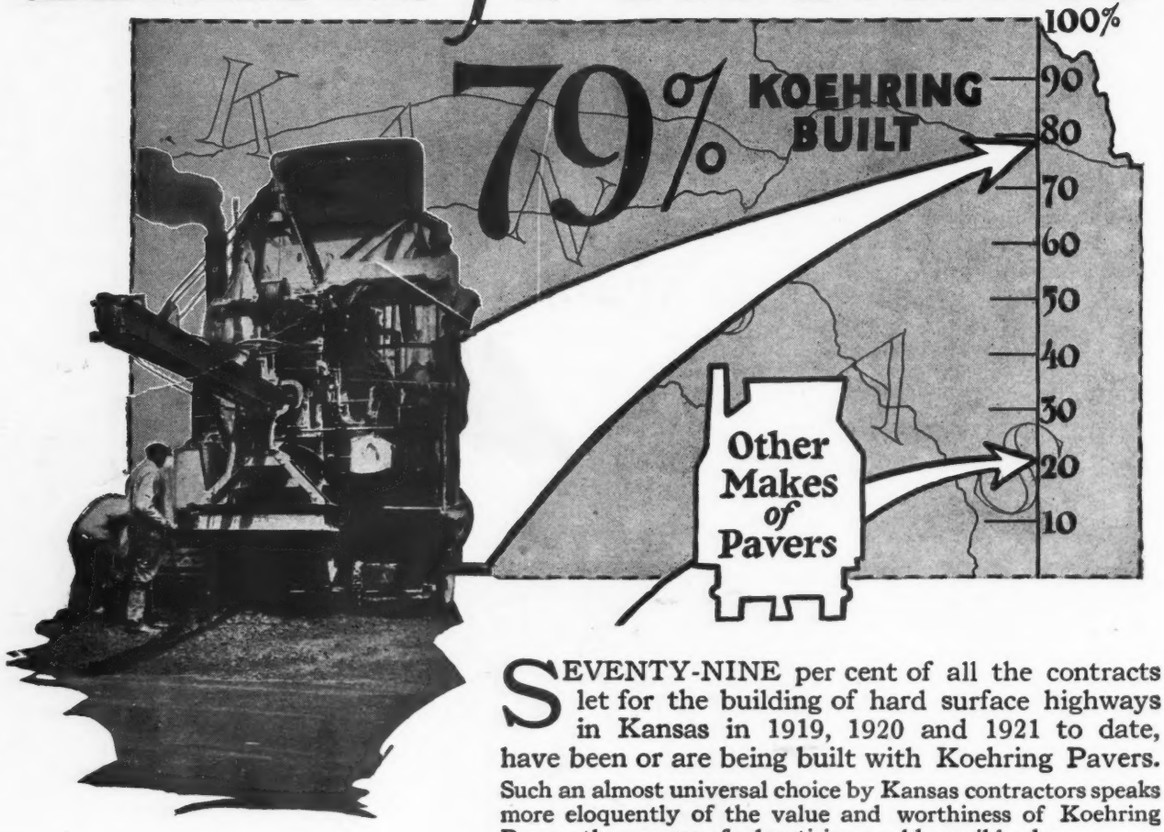
Book describing Hercules Products furnished on request.

HERCULES POWDER CO.

945 King Street

Wilmington Delaware

Kansas *for* KOEHRING



SEVENTY-NINE per cent of all the contracts let for the building of hard surface highways in Kansas in 1919, 1920 and 1921 to date, have been or are being built with Koehring Pavers.

Such an almost universal choice by Kansas contractors speaks more eloquently of the value and worthiness of Koehring Pavers than pages of advertising could possibly do.

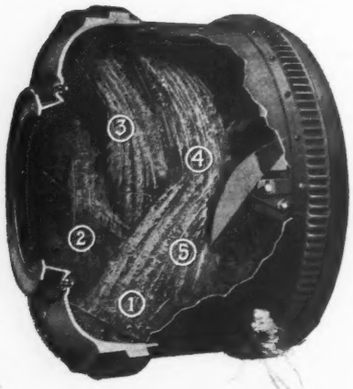
Here are the statistics:

Total number miles of concrete road let to date in Kansas	181.349
Total number miles of brick road let to date in Kansas	60.043
Total mileage of hard surfaced roads let	241.392
Mileage paved or being paved with Koehring machines	191.309
Mileage paved or being paved with all other machines	50.083
Percentage of Koehring paved roads	79.249
Percentage of roads paved with all other machines	20.752

Of the 181.349 miles of concrete roads let, 137.224 miles, or 75.668% are Koehring built roads. And of the 60,043 miles of brick roads let, 54.085 miles, or 90.077% are constructed with Koehring pavers.

The customer is the final judge of worth. And 79% of the state hard road builders of Kansas back their judgment that the Koehring Heavy Duty paver is the paver of absolute dependability.

Koehring re-mixed concrete is **DOMINANT** strength concrete.



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TECH TRADITIONS

By PROF. A. E. BURTON

Recently Retired Dean of Technology

Carmel-by-the-Sea, Calif.
September 7, 1921.

Editor, THE TECH ENGINEERING NEWS:

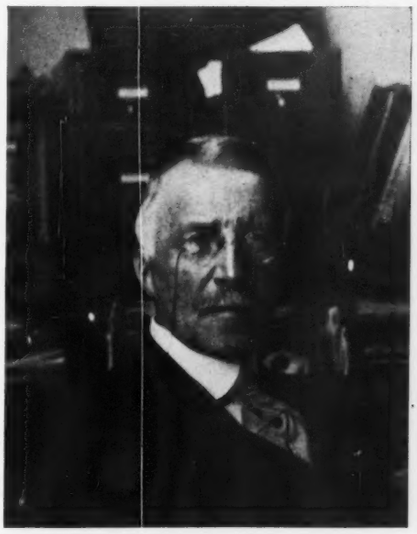
Your letter arrived yesterday and I am glad to comply with your request to write something on "Tech Traditions."

As the end of the vacation period approaches, I feel old habits drawing me back to Tech and it is very easy to imagine myself again in the Walker Memorial at the "All Technology Smoker" telling new students about "Field Day" and all that it means to Alumni and undergraduates.

The tradition of "Field Day" must be cherished as one of the distinctive things that, at the very beginning, puts the stamp of Technology on the new men; it makes them feel that they are a real part of the student life. As soon as they begin training for the foot-ball team, the relay, the tug of war, and the boat race, they are members of the Technology Clan and their loyalty becomes an asset to the Institute. These fair and strenuous physical contests satisfy the red blood of youth and, taking the place of hazing and indiscriminate rushing, impress on the new man the fact that he is entering a professional school rather than a college. The banquet to the contestants and the passing of the great silver loving cup are customs not to be forgotten.

"Founder's Day," commemorating the birthday of President Rogers, should continue to be celebrated by both Alumni and undergraduates. It gives an opportunity for unifying all the classes and stimulating a loyalty to Technology ideals.

The special smokers for welcoming students from other colleges should be a regular function at the Walker Memorial and every effort should be made to induce foreign students to take part in undergraduate activities. First stimulate



PROF. ALFRED E. BURTON

class loyalty and loyalty to the Institute will follow as a matter of course.

The most vital tradition at Tech is student responsibility. The undergraduate is held responsible for the right conduct of his own affairs outside the scheduled curriculum of study. Men come to the Institute with a definite and serious purpose and the atmosphere is that of a professional school but life is not all work and no play and the recreational activities that are so characteristic of American college life have their proper part in the development of a well-rounded personality. Such activities controlled by the students themselves furnish great opportunities for the development of initiative and managing ability. "Practical Human Engineering" is often better taught by encouraging student activities than by class room lecturing.

Student responsibility at Tech is concentrated in the Institute Committee. This Committee is representative of the entire student body and its decisions are regarded as final in all matters relating to the activities. The Institute Committee is in close touch with the Alumni Council and, through advisory members appointed by the Council, unity of sentiment and action between students and Alumni is insured.

The traditions of Junior Week have recently been adjusted to the satisfaction of all concerned and I trust it can be arranged next spring to have athletic sports a part of the festivities.

If I had been speaking at the All Technology Smoker, I should probably have made just such remarks as the above, and though they do not cover the whole range of "Tech Traditions," they do emphasize some of the things that I think most worthy of preservation.

Alfred E. Burton

NEW FISHERIES ENGINEERING COURSE

By PROF. S. C. PRESCOTT '94

Professor of Industrial Biology, Massachusetts Institute of Technology

On October 3 the Massachusetts Institute of Technology will offer to its students the opportunity of undertaking studies in a new and interesting field to which the name of Fisheries Engineering may be given. Obviously it is intended that this course shall train men to enter and develop the fishery industry in the same way that an Electrical Engineer works in the field of Applied Electricity, or a Sanitary Engineer in the field of Public Health, Water Supply and Waste Disposal on a large scale. In other words he is to bring to bear the facts and principles of science, and by such application there must come increased efficiency, improved methods of operation, and eventually a greater demand for the product which is developed.

BUILDINGS OF THE SEACOAST OYSTER CO., WELLFLEET, MASS.

Here a private concern is undertaking the improvement of the fishing industry, a thing which will be augmented by the graduates of Fisheries Engineering. Oyster seed is planted and after the proper elapse of time is gathered and marketed.

Whatever the actual reasons for the present decline in the fisheries industry, it is clear that this enormous industry, which should play such a large part in the development and maintenance of our food supplies, is in imminent need of trained men, and a new door of opportunity is open to the technically trained man. When it is borne in mind that the fishing industry was for decades one of the fundamental industries of America, and second only to agriculture, and that it still ranks very high (fourth or fifth) in our productive enterprises, it may properly be regarded as a field to which the aids of applied science should be directed. It may be claimed justly that here is an industry of enormous magnitude and still greater possibilities which has almost no attention given to it except through the work of the Bureau of Fisheries at Washington, whereas all branches of agriculture, stock raising, forestry, oil production, mining, and other industries based upon or utilizing the great natural resources are being fostered and aided by a large number of agencies, such as the Agricultural Colleges and Experiment Stations, Governmental Departments, and the Universities and Technical Schools. Let it be recalled that every state has at least one College of Agriculture and one or more Experiment Stations, all devoting time and money to help the farmer, the fruit grower or the stock raiser in the solution of his problems. Let it be remembered that at least a dozen schools of mining exist, even in states having no important mineral wealth, and many more are attached to technical schools and state universities. Similarly, and still more directly comparable with the fishing industry, schools of forestry have sprung up in considerable numbers, the aim of which is to aid the lumber industry, save the forests from depletion by unintelligent methods, conserve the timber supply indefinitely, and apply science to what was formerly done by "rule of thumb."

The problems of the fisheries are just as scientific, and the industry needs the same type of trained men if it is to survive and to handle with efficiency the questions of conservation and perpetuation of fish foods, improved methods of food preservation, and the prevention of the enormous waste that now takes place. The keen minds in the industry, those who have given deep thought to the matter, have claimed, and I believe justly, that if a suitable course of broad technical training could be supplied, in other words, if a new profession based on an old industry could be created, the industry would absorb eagerly the men so trained, and would be greatly benefited thereby, and that this benefit would quickly react to give us greatly improved fishery products and a stabilized industry. The leaders in this work would be essentially engineers or applied scientists in the same class with the agricultural expert, the trained forester or the mining engineer, for an engineer deals not merely with machines but with the forces and resources of Nature.

The training essential for men of this type, who will eventually become leaders in a great basic industry, must be broad as well as practical. As good citizens and men of affairs they must have general knowledge as well as specialized knowledge. Hence the course of study which they follow should be strong in general studies such as English, economics, mathematics and chemical and physical sciences. In the specialized fields there are certain lines of prime importance. Obviously the first to be considered is the biological, for the men must know much about fish, their habits, their enemies, their foods, their breeding peculiarities and their life histories. Since the fish are to be frozen, dried, canned and preserved in various ways, as well as sold in fresh condition, knowledge of the causes of spoilage and deterioration is essential. This involves a thorough study of microbic life or Bacteriology, and parallel with this, studies in organic chemistry and biochemistry. As the preservation of food materials by refrigeration, dehydration, salting, smoking or canning is based in every case upon the destruction or inhibition of bacterial life, the Technology of Fishery Products is in part a biological matter. It is in part also a matter of methods and machinery, so it is necessary for the fisheries engineer to have a sound fundamental training in mechanism, in the types of engines he is likely to have to use, and in the proper control of his machinery. Under the subject of Heat Engineering he acquires training to meet these demands. The mechanical and engineering subjects therefore comprise a second group of subjects. Navigation may also be included here.

A third group of subjects deals with the economics of the industry and with its industrial relations, and with general business administration. Accounting and cost accounting, statistics and their collection and use, industrial organization and business management and business law supply the needed fundamentals in this field. Under the general subject of business management will appear such important matters as transportation,

(Continued on Page 96)

THE EXPOSITION OF CHEMICAL INDUSTRIES

By C. R. ELLIS '23

Special Correspondent of The Tech Engineering News at the Exposition

The seventh national exposition of chemical industries this year proved to have the largest number and most extensive variety of exhibits ever shown, the exhibits exceeding 400 in number, and ranging from the Southern Railways' exhibit of southern chemical resources to detailed technical charts of the intricate processes involved in the manufacture of crude cyanide and ammonia gas.

Technology men were there in large numbers. A glimpse at the register of the convention showed that Technology was also well represented at the important meetings held before the exposition.

The keynote of the exposition, apparently, was the urgent necessity for additional protection in the form of tariff for our newest important industry—the manufacture of dyes. On every hand and in every way the attention of the visitor was continually called to the remarkable development of American dye-making during the past five years and the advantages to be gained by its continued promotion. Large placards containing such vital statistics as the growth of the industry from seven manufacturing establishments in 1914 to ninety in 1920 were posted at various strategic points.

German maufacturers, it is maintained, are already making serious inroads into our recently-built dye trade, and to insure the very existence of the American industry, which is so essential in time of war, much greater protection from, if not exclusion of, German dyes is immediately necessary. "Ten thousand chemists," says one of the placards, "are already out of work," ascribing the cause to the nefarious Teutons.

The dye exhibits themselves were veritable monuments to the stupendous growth and remarkable ability of the American chemical manufacturer who is now asking for adequate protection. To the lay eye, they seemed to include every possible variety of color and texture. Silk, wool and cotton dyed in brilliant hues decorated the booths with oriental lavishness. The artistry of these American-dyed textiles provided pleasing bright spots against the sombre background of the more technical exhibits.

An unusually interesting exhibit was that of the Sandoz Chemical Works, New York City. They exhibited a three-color chromatic chart which from a distance appeared to be a clever piece of brush work. Upon closer inspection, it proved to be constructed of 231 diamond shaped pieces of woolen cloth, individually dyed.

Students of Courses V and X would have revelled in some of the exhibits which showed in more or less detail the complete processes by which various chemical products are manufactured on a commercial scale. Exact models of entire chemical plants were shown in some booths, while others contained full-sized machines in actual operation. The Bailey Meter Company, Cleveland, Ohio,

All the colors of the rainbow—and an oriental rainbow at that—the concentrated noise of a dozen machine shops, and enough signs advocating protective tariffs on dyes to elect at least three senators greeted the visitor to the Seventh National Exposition of the Chemical Industries which was held the week of September 12th in the Armory of the Eighth Coast Artillery, New York City.

showed a miniature boiler in operation. One side of the boiler and firebox was made of glass which allowed complete vision of all the activity within and also showed exactly where the various meters are advantageously located. Another model in surprising and complete detail was a horizontal flue furnace used in the Semet-Solvay process. The manufacture of lime was shown in complete detail in another model. Medicinal bottle-filling and tube-filling machines were exhibited that seemed almost human in their movements.

Canada was well represented by two of her exhibits, that of the Canadian Pacific Railway and that of the Canadian Department of the Interior. The former showed a map of their entire system with stations represented by miniature electric lights controlled from a master board at the hand of the demonstrator. The feature of the board was the ability to instantly show the distribution and locations of Canada's resources by merely pushing the switch controlling the particular lights in the vicinity of that material's various locations. The Department of the Interior exhibited raw materials of infinite variety, but particularly those of interest to the chemical engineer. An illuminating map of Canada's developed and potential water power was also on view.

The booth of the Southern Railway System would have been a revelation to the visitor unfamiliar with the southern United States. They, too, had an infinite variety of raw materials on view, all products of the south.

To the lay mind, the exposition was marvelous in its showing the extent of the American chemist's ability and versatility. Massive earthenware pots for use with acids, attractive suits of men's clothing made of woven strands of paper, a large Liberty Bell cast in pure sulphate of aluminum, a Liberty airplane propeller fashioned from "Micarta," new and strong metals made of magnesium alloys one-third the weight of aluminum, and as strong as good steel, were fashioned into machine parts, heels for women's shoes.

(*Continued on Page 98*)

VIEW OF THE EXPOSITION OF CHEMICAL INDUSTRIES
Held in the Eighth Coast Artillery Armory in New York City

DEAN HENRY PAUL TALBOT

By DR. JAMES F. NORRIS

Professor of Organic Chemistry, Massachusetts Institute of Technology

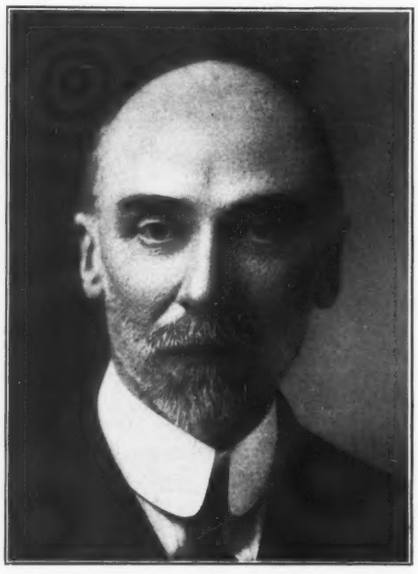
From the point of view of those connected with Technology, the retirement of Dean Burton and the appointment of Professor Talbot as acting Dean were, no doubt, two of the most important events of the last school year at the Institute. The students, especially, are anxious to learn the record and personality of the man who is to be their representative in the Faculty—the man to voice sympathetically their point of view as a body and to look after their individual interests. They want to know something definite of the one to whom they are to turn for council in their handling of the difficult problems that arise in connection with student government and other activities of the student body. I have been asked to sum up the more important events in the academic and scientific life of Professor Talbot and to sketch his personality. I have been associated with him for a number of years as a colleague in the Department of Chemistry and have had the opportunity to see how he handles men and things. After ten years of absence from the Institute my return made it possible to observe with the point of view of an outsider—with the perspective that is often lost by continuous association.

The student reserves his respect for the man who has accomplished things in the world and his confidences for the one who will meet him half-way with sympathetic interest. A review of the record of Professor Talbot as a chemist and administrator and a brief account of how successfully he has maintained an intimate and cordial relationship with the students of his department will assure the student-body at the outset that they have in their new Dean a man whom they can respect for his attainments, in whom they can confide, and one whose advice and judgment will be valuable.

Professor Talbot graduated at the Institute in 1885 and received the degree of Doctor of Philosophy from the University of Leipsic in 1890. He returned to the Institute as an instructor and was rapidly promoted through the several grades and was finally appointed Professor of Analytical Chemistry in 1898. He showed marked administrative ability and from 1895 was nominally in charge of the Department of Chemistry, although his official appointment to this post was not made until 1901.

Professor Talbot's training in chemistry was broad; his work as a student equipped him with the point of view of the analytical chemist; his research for the doctorate was in organic chemistry; and he devoted much attention to the study in Germany of the new physical chemistry which was being rapidly developed at that time. He was impressed with the importance of the advance of the science in this direction, and on his return from Germany he introduced at the Institute a course in physical chemistry, which he taught successfully. This course was one of the first in this subject given in American Universities.

When Professor Talbot took over the



Henry P. Talbot

instruction of the first year students, he felt the advisability of bringing before them the more fundamental concepts of the newer chemistry. He accordingly prepared with the assistance of Professor Blanchard a text for this purpose entitled "The Electrolytic Dissociation Theory." Professor Talbot's progressive action in these two cases is typical of his attitude in educational affairs. He has been the leader in the development of his department to its present efficient condition and has served as chairman of committees on chemical education in the American Chemical Society and the Society for the Promotion of Engineering Education. Professor Talbot has shown unusual interest in the teaching of high school science, and has been helpful in organizations devoted to the improvement of teaching in this field. He served as President of the New England Chemistry Teachers' Association and was for several years chief examiner in chemistry of the College Entrance Examination Board.

Professor Talbot's record as a member of the American Chemical Society brought to him last year the honor of election as one of the five directors who determine the more important policies of the Society and have full charge of its finances. He has been a member of the Council since 1898; he has served as associate editor of the Journal of the Society and as Chairman of the Division of Inorganic and Physical Chemistry. He has also been a member of many important committees.

During the Great War, Professor Talbot was appointed a member of a small committee to act in an advisory capacity to the Bureau of Mines in the work it had undertaken in correlating the chemical activities of the country to meet the problems arising from gas warfare. He was particularly helpful in presenting to the Secretary of War directly the needs of this organization, which carried on for over a year, outside of the War Department, all the work on war-gases.

Professor Talbot has always been interested in research. In the years following his return from Germany he published the results of several investigations in the field of inorganic and analytical chemistry. For a number of years he was chairman of the committee of the American Academy of Arts and Sciences that has charge of the C. M. Warren Fund, the income of which is devoted to aiding chemical research. In recent years, the small amount of time available after he had completed his work as a teacher and administrator has been devoted to editorial work and the writing of papers on educational, scientific, and industrial subjects. He is the author of a widely read text book on Quantitative Analysis. Professor Talbot is the Consulting Editor of the International Chemical Series, which comprises books on a wide range of subjects in the field of chemistry. During the war the Atlantic Monthly published a series of papers by him on gas-warfare. These were written in the interesting and lucid style which is characteristic of all of Professor Talbot's writings. As Chairman of the Faculty, and of the Administrative Committee since the death of President Maclaurin, Professor Talbot has had much to do with shaping the recent policies of the Institute.

Professor Talbot's work has always been appreciated by chemists, and it was with pleasure that they heard last June that Dartmouth College had bestowed upon him the honorary degree of Doctor of Science. In bestowing the distinction his record was summed up as follows: "Henry Paul Talbot—Administrator and Scholar, faithful and versatile contributor to the welfare of a distinguished sis-

ter institution of high learning; scientist whose interest in the discovery of new truths is matched by instinct for the application of those truths, of whose knowledge you have possessed yourself; by virtue of the authority vested in me, I welcome you to the fellowship of Dartmouth men and I confer upon you the honorary degree of Doctor of Science."

In the midst of all his scientific, educational, and administrative activities Professor Talbot consented to serve as acting Dean for the present year. A factor involved in his decision was, no doubt, the conscientious attitude which has been a marked element in his character. If he saw a duty he undertook it and put his best efforts into it. A colleague, who was a former student of Professor Talbot, considers his conscientious makeup to be his outstanding trait; he always had his lectures in such form that it was possible to take logical and well balanced notes; and he always saw that every student got a "fair deal."

When Professor Talbot came to the Institute there were no student activities; no "Tech," no "Show," and fraternity life had not been developed. Although he did not have the advantages that come from these important factors in making men of boys and in developing character and poise, he has always valued them. A former student said that a number of his fellows were led to join fraternities through the high opinion of them expressed by Professor Talbot. His sympathetic attitude was recognized by his election several years ago to active membership in the Phi Gamma Delta and Alpha Chi Sigma fraternities. In 1914 the Technique was dedicated to Professor Talbot, an honor the meaning of which the students know best.

Professor Talbot's belief in student activities has shown itself in the interest he has taken in the Students' Chemical Society, which has grown to be an important aid in developing its members. This attitude towards the various organizations controlled by the students has its foundation in the keen personal interest Professor Talbot has always shown in the students as individuals. One of my colleagues, in pointing out the cordial relationship that exists between Professor Talbot and the students who get to know him, noted the fact, evident to us all, that Professor Talbot has retained the spirit of youth. It could not be otherwise with the pleasure he derives from association with youth. For years his home has been open informally to his students and many of the graduates of the Institute recall the hearty greeting they always received and the "Southern hospitality" of Mrs. Talbot. It will be of interest to the new students to know that Mrs. Talbot has the qualifications and sympathies that will make her an efficient helper to the Dean. There are occasions in the life of a young man just from home when the advice of a woman is valuable.

Professor Talbot knows the student well. For a number of years he took an active part in the instruction of the freshmen and met the seniors in chemistry in small classes in which all formality was dispensed with. In the course called "Thesis Reports" he took the opportunity of training men in the art of talking on their feet; and he corrected in a friendly spirit many faults in personality which stood in the way of success in the intercourse with men.

Those of us who know him best feel confident that the students will find in their new Dean a man after their own hearts.

THE OUTSIDE OF CHEMISTRY

By ELLWOOD HENDRICK

Consulting Editor of "Chemical and Metallurgical Engineering"

In regard to chemists as a body of men and their standing in the community, we may say that they are not recognized by their works, but are known by their respective personalities. If they are agreeable and understandable they give chemists a good name, whereas if they are ignorant beyond their profession or ungracious in demeanor they give to chemists as a body the repute they themselves have earned.

Time was when the lawyers had things very much their own way. They claimed to represent the high intelligence of the community and they made such a to-do about their "trained minds" that the rest of us nodded acquiescence, elected them to about all the available offices, in public and corporate life, and to our great harm, many of us strove to imitate them. The lawyer is trained to weigh evidence, to distinguish between that which is technically admissible and that which is not, and alas for the cause of truth!—to allocate factors of evidence to prove a theory of a case rather than to reach the truth.

The man of science is trained to correlate facts, which is a very different art. It calls for higher ideals than the winning of cases. It provides a royal road toward the great white light of truth, and it helps towards the advancement of man. In the ordering of our lives we haven't a high Court of Appeals for the reversal of decisions and the mending of errors. We have to bear the burden of every mistake—and pay the costs. Therefore I venture the opinion that the best trained mind to deal with human affairs is that which has enjoyed a basic training in science.

It is surprising how often we find men of science lame in speech and deficient in the selection and use of words. The reason is mainly due to a defective concept of their professional requirements during the years of training. The chemist, for instance, needs the theory and the facts as well as an active imagination, but to get along in the world, to sell his services and to enjoy life, he needs something more, and that is a happy facility of expression. It isn't society manners; it is a far profounder thing. It calls for sympathy to understand others and the wit to perceive when they understand. The lawyer is compelled to learn how to explain what he means to his clients, to juries and to judges, and so the achievement of facility of expression is made a part of his education. The chemist is in no less urgent need of it for his own personal welfare and to establish himself in the world. If he is a factory manager, he needs it all the more because the laborers with whom he has to deal are likely to be less subtle in understanding than a lawyer's clients, or the judge before whom he pleads, or even than the twelve good men who constitute the jury. The more intelligent the audience, the easier it is to speak if one has something to say.

A man can address himself to courses in English and Philosophy until the cows come home, and yet miss the art unless he sets his mind upon it. On the other hand he can forego all the cultural courses, develop a taste for good books and read them and be the real thing, the representative person, the kind of man chemists like to point out with the remark that "he is one of us."

The standing of chemistry in the United States is being established now as a major profession. If we are a bunch of "rough-necks," we shall be called upon when needed and otherwise left severely alone. The pleasant things of life will drift away from us. But if we learn how to put wings upon our words they will do us honor as they fly. They will also bring back the olive branches of welcome in a world which, in these days, is not organizing itself for the amenities of life.

A railway statistician has figured out that "the railroad trains have to jump the track 118 times to kill one man." It's a lot of trouble and it takes a lot of time, but they manage to do it several times each year.—(Kansas City Star)

MOUNTAINS OF OIL

By T. P. CAMPBELL '21

Graduate of Dartmouth College 1918

In a recent report to the Secretary of the Treasury, the United States Bureau of Mines said:

"The United States Geological Survey makes the pessimistic report that our underground oil reserves are 40% exhausted, and that we are probably near the peak of domestic production. The consumption of petroleum is increasing far more rapidly than domestic production. Our future supply of petroleum must be preserved . . . because:

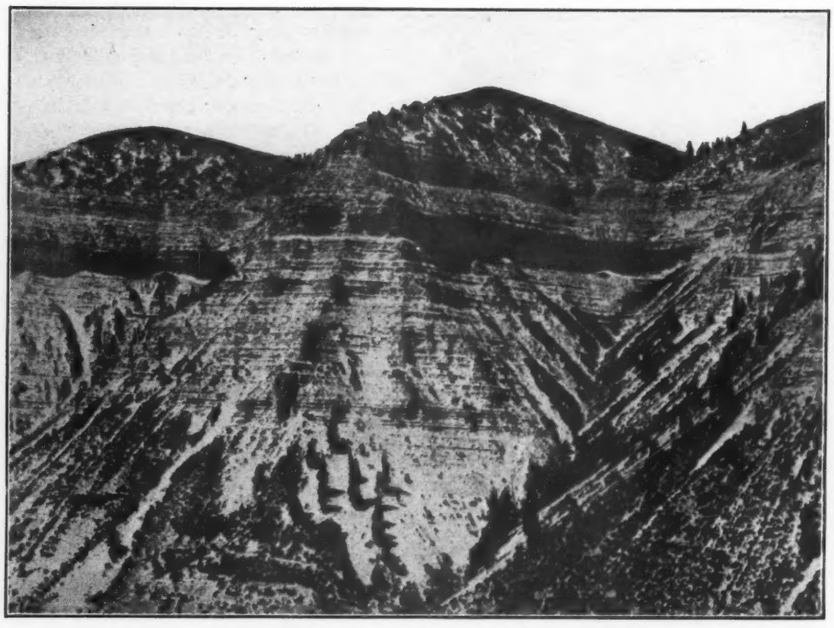
"First, petroleum has become the fundamental basis of the industrial and military life of the nation.

"Second, the potential supplies of crude oil outside the United States are passing almost entirely into the political and economic control of foreign governments; and the United States is likely to pass the position of dominance into a position of dependence.

"Third, investigations of the Bureau of Mines, of the Fuel Administration, and of other bodies have disclosed that the known oil reserves of the United States are not receiving adequate protection, and are being wasted through inefficient methods in production, refining, and utilization of the oil."

Of late years this petroleum problem has become more and more vexing. Every report on the matter has shown increasing inroads into the storage reserves; every month magazines and journals have contained articles bemoaning the present shortage and questioning the adequacy of the natural reserves to meet future demands.

These lamentations and direful predictions fail to take into account, however, the birth, in the last two years, of a new industry with a potential supply of raw material that defies mathematical computation and staggers the imagination. This is the age of oil. Oil we must have. The supply must come, then, from our great deposits of oil shale. "If oil is 'King,' then oil shale is the 'Heir Apparent.'"



CLIFFS OF OIL SHALE ALONG BRUSH CREEK, COLORADO
The level strata make mining of the shale very accessible

To gain some idea of the vast oil supply which these shales make available, the following figures may prove suggestive: An acre contains 43,560 square feet. A seam of oil shale 10 feet thick would contain 435,600 cubic feet of shale. Eighteen cubic feet of shale weigh one ton. Hence there are 24,200 tons of shale in one acre of a seam 10 feet thick. In one square mile there are 640 acres, and, therefore, 15,488,000 tons of shale. There are 2500 square miles of shale in Colorado, or 38,720,000,000 tons. Assume that only one-half is available, and there still remains 19,360,000,000 tons of available shale. This is figured for one ten-foot seam only. A conservative estimate is 30 feet of workable shale, or a total of 58,080,000,000 tons available shale. A fair average production is one barrel of oil to a ton of shale, or 58,080,000,000 barrels of oil available. To treat this amount of shale would require 100 plants treating 2,000 tons each per day in continuous operation for 290,400 days, or 800 years approximately. Notice that these figures apply to Colorado alone. There are also large deposits in Utah, Wyoming, Nevada, Montana, and California.

In view of these facts, some elementary knowledge of the shale deposits and of the industry utilizing them might not be amiss. In the first place, oil shale must not be confused with oil sand. "Oil shale contains practically no oil as such. It is a consolidated mud or clay deposit from which oil can be obtained by destructive distillation. In appearance the shale is black or brownish-black; but on weathered surfaces it is white or gray. It is usually fine-grained with some lime and occasionally sand. It is tough, but, in thin sections, friable. A fresh surface may give an odor of petroleum; and thin, rich sections may burn with a sooty flame.

"Oil shale is one of a long list of natural deposits which result from the deposition of organic matter from plants or animals of a former geologic era. The beds of oil shale were laid down in lagoons or other wide expanses of quiet water. They contain a large amount of organic matter; low plant forms like the algae; also pollen, fish scales, insects, and remains of animal and vegetable life often changed beyond recognition."

The oil shales of Colorado belong in the Green River (Eocene) formation. As time is counted in geology, this part of Colorado was recently an extensive plateau through which the Grand River and its tributaries have cut valleys to a depth of 3000 feet or more exposing on either side of the streams great beds, or even mountains, of oil shale. The beds thus exposed are regular and virtually level; the greatest dip noticed so far is only ten degrees. The level position of the beds enables the oil shale to be mined by the ordinary methods of room-and-pillar coal mining. Also the position of the beds high above the level of the streams makes it possible to handle large quantities of shale by gravity, thus reducing the cost of conveying and handling machinery.

The oil shale industry is not new. It has been successfully developed and operated in Scotland for the past fifty years. In 1850, James Young, as the result of a lengthy investigation on the distillation of oil from bituminous coal, secured a patent which became the basis of a new industry. The salient feature of Young's invention was the distillation of bituminous materials at the lowest possible temperature for the production of volatile compounds. In practice it was found

that the best results were obtained at about 800 degrees F.

The problems which must be met and solved are many and complex. To be sure, we may profit by Scotch experience; and in devising new processes we cannot well afford to disregard completely the fundamentals which are embodied in the Scotch plants. However, the American shales differ considerably from the Scotch. Our shales yield about 42 gallons of oil to the ton, and are low in nitrogen content. The Scotch shales are low in oil and high in nitrogen. The sulphur content of our shales is lower, generally, than that of the Scotch shales. It must be apparent, then, that we have our own row to hoe; we can get a good start from Scottish practice, but after that we must resort to our own skill, patience and ingenuity to put the industry on a commercial footing.

At the present time, a number of different types of retorts have been designed for the production of shale oil. Some are of commercial size; others are just large experimental or demonstration units. The majority are designed to produce a crude oil from shale to be sent to a refinery; but others have attempted to effect distillation and refining in one operation.

A well-made shale oil should yield 16% to 20% of gasoline or motor spirit, and about 40% of the kerosene fraction. These will contain 60% to 70% of unsaturated hydrocarbons or olefins. The kerosene and a small portion of even the heavier distillate may be taken off and cracked, bringing the total gasoline yield up to about 40%.

After refining the spent shale contains something less than 1% of soluble potash. Under present conditions this could not be extracted at a profit. In some places the shales contain an appreciable amount of gold; but the quantity is too small and its occurrence too irregular for it to have any commercial significance. Experimenters have produced, in their laboratories, many different substances from shale oil, such as dyes, high explosives, rubber substitutes, etc., but it is unlikely that the manufacture of such substances will be undertaken commercially until the profitable production of gasoline, oils, and ammonium sulfate is firmly established.

As for the future possibilities of the oil shale industry in the United States, the following statement from the Bulletin of the U. S. Bureau of Mines, by Gavin, Hill, and Perdew, states the case very clearly:—

"In this country, the oil shale industry cannot be developed over night and probably cannot attain success until large sums of money have been spent in perfecting mining, retorting, and refining methods. A company, to be successful, whenever oil shale operations become commercially feasible, must be able to employ the best technical, business, and engineering skill available, be prepared to operate on a large scale, and be financially strong enough to wait several years for any return of the money invested. A large amount of credit will naturally be due those pioneering companies that will carry development work so far that whenever the petroleum industry fails to meet the demands for its products, the oil shale industry will be in a position to meet the deficit. It is unfortunate that a number of the many companies organized to deal with oil shales are devoting their efforts to stock-selling rather than assisting in building a firm basis for the industry."

PIPE SYSTEMS OF OIL TRANSPORTATION

A feature in the development of the oil industry in this country has been the introduction of long pumping mains for conveying oil from the producing districts to the oil refineries. These lines date back about 56 years and aggregate now 45,500 miles, according to a paper by C. P. Bowie, petroleum engineer for the U. S. Bureau of Mines. Of this total, 34,000 miles are trunk lines, usually of 8-in. pipe; the remaining 11,500 miles are gathering systems of 4 or 6-in. pipe, running from the tanks at the wells to those at the head of the trunk line. These gathering systems may be owned either by the producers or the trunk line companies.

This method has largely superseded other methods owing to the low cost and has made it possible to establish refineries near the large consuming centers instead of in the remote producing districts. When most of the trunk lines were built the cost averaged $6,500 per mile of 8-in. line and $130,000 to $250,000 for each pumping station, the present fixed investment being estimated at $500,000,000.

Threaded steel pipe is used, the 8-in. pipe for trunk lines designed to withstand a 2,000-lb. pressure and carrying a working pressure of 700 to 900 lbs. In locating a pipe line, rough country and swamp land are avoided as much as possible. For private right of way, land may be purchased or a permanent easement may be secured to give the owners of the pipe line free access to their property. In some states the land may be obtained by condemnation

In construction work the right-of-way gang first clears the site, placing culverts or casings at railway crossings, and if necessary building roads to facilitate the hauling of the pipe. Then comes the stringing gang which distributes the pipe; this work often involves hauling material for long distances over difficult country. When a considerable stretch of pipe has been distributed the pipe-laying gang connects the joints; 40 men with pipe tongs will connect up from 2500 to 4000 ft. of pipe in a 9-hour day. A more modern method is to use a pipe jointing machine and 28 men with such a machine have connected up 8700 ft. of pipe in one day.

Next comes the ditching gang to dig the trench and lay the pipe; in some cases the ditching being done first, the joints being then made with the pipe resting on skids or sleepers over the trench. Where the cost of trenching would be excessive or when the soil is strongly alkaline the pipe may be laid on the surface, resting either on the ground or on sleepers. If necessary to bury it in such soil the pipe is coated with asphalt and while this is wet a layer of roofing paper is applied and covered with a second coating of asphalt.

Pumping stations are spaced at distances ranging from 1½ to 90 miles, the distance depending upon the topography of the country and the viscosity of the oil. In the eastern and central states the average spacing is about 35 miles, but in California it is only about 12 miles, owing to the relatively thick and viscous character of the oil. The pumping equipment depends not only upon the quality and quantity of oil to be handled but also upon the fuel and water supply conditions, both steam and internal combustion engines being used. With 700 to 900 lbs. pressure on the line the pumps can deliver through an 8-in. pipe about 30,000 barrels of oil in 24 hours.—*Engineering News-Record.*

An approach to the scientific measurement of color has been made in the Eastman Kodak Co. colorimeter. It resembles a telescope in appearance, an image of the colored object being formed in one half of the field of vision. The other half is illuminated by a beam of light which is standardized by passing through a tungsten-to-daylight filter. Four special absorption wedges are provided which may be moved across the path of light by small knobs sliding on a scale graduated from zero to 30. The three upper wedges cut out the green, red and blue rays, respectively, from the standard light, while the lower or neutral wedge is used for varying the intensity. When a color has been matched by suitable manipulation of the wedges, the position of the knobs on the scales are read off, giving a numerical expression for the color value.

MUNICIPAL FIRE ALARM SERVICE

By V. C. STANLEY

Vice President, Gamewell Fire Alarm Telegraph Co., Newton Upper Falls, Mass.

Nearly everyone has observed red iron boxes on posts at occasional street corners, and near the entrances of some prominent buildings, and has sensed that they are "Fire Alarm Boxes"; yet very few persons,—whether in the common walks of life, among municipal office holders, or even in engineering professions,—have more than a very vague idea of the underlying requisites of successful municipal fire alarm service.

A fire alarm system,—to be worthy of the name, should be an agency constantly and readily available to the public whereby warnings of the existence and location of fires may be swiftly and accurately imparted to the fire fighting organization by persons of ordinary intelligence, even when acting under the stress of excitement and without previous instructions or experience in so doing.

The oft abused adage that "Half a loaf is better than no bread" should never be applied to fire alarm problems, —not only because protection of lives and property from the fire hazard justifies the use of the most effective and reliable agencies known to science,—but more especially because any fire alarm system which fails when needed, tends to delay the arrival of the firemen; thus increasing (instead of tending to eliminate) the likelihood of a fire attaining such proportions as to result in the loss of lives and extensive property destruction.

Commercial telegraph, telephone and railway signal services are frequently compared to fire alarm service, but such comparisons are very misleading. Telegraph offices and telephone exchanges have trained and experienced operators who are constantly sending and receiving messages, and almost every circuit they have occasion to use carries many messages per day. Nearly every one uses telephones at comparatively frequent intervals; and, because of the very nature of the service, users are immediately cognizant of any failure of the apparatus and lines to transmit their signal, and will usually act to repeat their signals, and to avail themselves of some other line or instrument, or some other means of communication, if their call does not secure the intended acknowledgment within a very few seconds. Furthermore, the public is now fairly well trained to await their turn before attempting to use a "party line" which they find to be in use when they desire to send a call.

Statistics indicate that an average of but one person out of every 450 of our population operate a fire alarm once within the span of an average lifetime; boxes should therefore be so arranged that a primitively simple manual act will serve to start an alarm and so that, without the need of further manual attention or co-operation, and in spite of frantically applied ill-directed efforts or even malicious tampering thereafter, the transmission of the alarm will be unerringly and effectively completed if the circuit is not already occupied in transmitting some other signal, and, even if so occupied, will be effected promptly after the conclusion of such other signal.

Failure or inoperability of telephone or telegraph lines or instruments is quickly disclosed and need cause little disaster, as neither life nor property are likely to be jeopardized by the delay incident to an ineffective effort to use an inoperative telephone or telegraph circuit or instrument, even when added to the time lost in transferring activities to another instrument or a parallel circuit, such as are almost invariably available for emergency messages in existing commercial telephone and telegraph systems. Even under the exacting conditions of automatic railway signal service, the systems are designed with a view of giving a danger or stop warning when the circuits are broken, batteries disabled or instruments out of order; thus, at worst, merely causing a needless stoppage of a train,—or a "safe failure,"—but substantially incapable of failing to give a needed warning signal.

It should be noted that railway signal systems may be arranged so that it requires action to permit a train to proceed. Inaction or absence of an intended signal is interpreted as a warning for a train to stop. If the inaction results from a broken rail, an open switch, the situation of a car in a siding where it provides insufficient clearance from the main-line, or the presence of a train in the block ahead,—incident electrical de-energization, and hence the failure of the "hold clear" magnet, will cause a warning signal which should save an approaching train from disaster; and if such a signal is given when there is no such broken rail or obstruction, it is nevertheless a justifiable signal and cannot be treated as totally false, because it gives warning of the fact that the further progress of an approaching train will lack automatic signal protection; hence, the annoying stoppage of the train because of any so-called "signal failure" constitutes a bonafide warning of the existence of a danger almost as serious as a broken rail, and requiring the exercise of extra caution in the further progress of the train.

Such practices are made possible in railway signaling service because it is practicable to provide a separate signal for each unit of territory protected; such signals being located at the portals of the respective territories they protect, and are thus available for observation by those having occasion to enter. In fire alarm practice the conditions are reversed, and,—instead of providing signals through which those who have occasion to do so may be apprised when it is safe to proceed,—an alarm is needed which will instantly attract the attention of persons in various localities, regardless of preoccupation or even slumber, and which will accurately apprise each and all as to the exact locality at which their services are needed.

In view of the foregoing it is apparent that the practices followed in telephone, telegraph and railway signaling are inadequate for municipal fire alarm service, and this applies both to electrical and mechanical considerations.

In order to meet the exacting requirements of fire alarm service,—all metallic normally closed circuits are employed; the current flow in each circuit is constantly maintained at a strength at least sufficient to cause intended energization of the electro-magnets of all apparatus; and the transmission of signals is effected by alternately breaking and closing the circuits in accordance with a prearranged code, such breaks and closures being automatically formulated by the running of clockwork mechanism. Bells and visual recorders responsive to circuit breaks serve to direct attention to and facilitate correct interpretation of signals, and also serve to instantly and conspicuously disclose accidental interruptions of current flow, whether resulting from circuit defects or failures of the current supply.

The designs, materials and methods which enter into the construction of fire alarm equipment should be selected only from those whose characteristics are well known and which have proved suitable for the requirements which they should serve, as such equipment is not subjected to frequent actuation and, particularly in the case of fire alarm boxes. there is no opportunity for routine operation or use, yet these instruments should surely and correctly transmit an alarm whenever an occasion requires,—even if such occasions do not arise, for given individual boxes, more than once in many months, or, as is frequently the case, once in several years.

Conditions of heat and cold, numidity or other corrosive contents of the atmos-

(Continued on Page 92)

BETTER LIGHTING

By PROF. W. J. DRISKO '95

Associate Professor of Physics

In quantity production every progressive industrial executive realizes that any advance in the way of greater comfort and safety, better health, and surroundings that induce a happy state of mind of the operatives, produces a net saving to the plant either through a reduced cost of a given output or else through better or larger output for the same wages. Experience has shown that among the factors which have direct bearing on both safety and production, proper illumination is one of the most important. It must be kept in mind that proper and adequate illumination means not simply light enough to enable one to see reasonably well, but rather light of such quality and so distributed that each

BEFORE

A factory improperly lighted, worthy of the dark ages. Accidents are inevitable here.

operative shall be performing every bit of his task under the most favorable conditions of seeing.

Better illumination results in greater accuracy in workmanship, hence a better product; greater speed, i. e., increased production at the same cost; reduction of accidents, hence less lost time for both operatives and machines; reduction of eye-strain and consequent headaches which result in increased spoilage and "seconds"; longer period of usefulness of operatives, due to the lessened visual effort. Among the indirect factors which better lighting produces, one must note the greater cheerfulness of surroundings, increase in order and neatness which result in noticeable pride in a better product, and perhaps more important than either, the improved sanitary conditions which always seem to follow good lighting.

In 1910 it was shown quite clearly that 24% of all our industrial accidents were due to either improper or inadequate lighting. During the past decade "safety first" has had a very pronounced effect on the lighting of our industries. There has also been a very general dissemination of information on the physical, physiological, psychological, and engineering aspects of lighting by various interested organizations, while at the same time there has been a very wholesome co-operation of the insurance companies who have a very vital interest in accident preventive measures. No thorough survey for the past year has yet appeared, but from general observations and reports it has been estimated that about 15% of our industrial accidents are due to bad lighting. These accidents, in many instances, are not due to insufficient lighting but rather to faulty lighting, e. g., lights in the wrong place (causing eye-strain, headaches, etc).

Granted that 15% of our industrial accidents are from bad lighting, we can estimate how much it costs. If we assume the average weekly wage at $20 and reckon another $20 per week to cover medical attendance, insurance, loss of production, etc., the total annual accident loss figures at $2,000,000,000 of which $300,000,000 is chargeable to poor lighting. This sum is considerably in excess of our total annual industrial lighting bill.

Mr. R. E. Simpson of the Travelers Insurance Co. states that "During a one-year period in this country, the number of accidents due to inadequate or improper lighting exceeds the yearly rate of war casualties." He has also shown that in the United States alone there is a total loss to production from accidents, mostly preventable, of 180,000,000 man-hours per year or the equivalent loss of 600,000 men for the full working year of 300 days. Massachusetts alone paid in one year $1,000,000 in accident loss attributable to poor lighting.

Moreover, poor illumination cuts down production in several ways. A workman may be obliged to scrutinize his work, make unnecessary moves to get a more favorable view, or may make some procedure in several steps that might well be made in one under light of so-called "productive intensity." All of these delays mean not only loss of time to the operative but in general to his machine as well. When seeing conditions are not good, mistakes are more frequent, spoilage is much greater.

The increase in production due to better lighting has received a great deal of attention recently with very important results. On account of the great variation in conditions of production the results of such investigations have been somewhat discordant. The British Government considers that the average gain in production due to improved lighting is eleven per cent. The French Government estimates this gain at from eight to fifteen per cent. Private investigations in both England and America have placed the gains in various industries at from five to fifty per cent. Our National Electric Lamp Association places the average gain conservatively at five per cent. One can readily see that the gain from increased illumination in a freight shed, a stock or storage room, or a foundry might be very small in comparison with that in industries requiring close scrutiny by the workman.

There, of course, remains the further question of the cost of such lighting improvements as are in general necessary to bring production to its maximum. Industries are so varied in their demand that no very definite figures can be giv-

AFTER

The same factory after proper methods of lighting had been adopted, a credit to engineering.

en but in a general way in factory production an operative occupies about one hundred square feet of floor space. Illumination varies from one to two foot candles in a foundry, to twelve to twenty foot candles in a jewelry or watch factory. A fair average would be four foot candles. The average operative works 2700 hours per year, about 900 of which are under artificial light. From these figures, it can be shown that the average cost of lighting is from two-tenths of one per cent to five-tenths of one per cent of the wages, i. e., for every ten dollars paid for wages from two to five cents are paid for light,—almost a negligible quantity.

Daylight, like the air we breathe, is so universal that we consider it part of our natural environment and placidly assume that it costs nothing. It has been shown that for large factories, where the amount of glazing is enormous, the total cost of light per year would be less if there were no windows whatever and the illumination were entirely artificial. It may be a question that sanitary engineers will have to

(Continued on Page 102)

MONTHLY NEWS

New Process in Print Making.—A new process by which a plate is made directly from linotype slugs, declared to reduce very greatly the cost of book making, has recently been invented by I. W. Litchfield, '85. The increased cost of electrotypes has been an added impulse to the development of the new method, which actually eliminates the electrotypes.

The "linoplate" process, as it is called, embodies the making of a plate by taking a page of line slugs and cutting them parallel with the type face at the depth of an electrotype. The back of the type is grooved lengthwise with the page, in four places; steel wires are inserted in the grooves and solder is applied. The lines are thereby transformed very simply into a strong plate. A nickel bath is applied to the face of the type, making it very durable. The cost of plates made in this way is said to be about half that of electrotypes.

An Aeronautical Engineering Course which will occupy five years has been established at Detroit College. Special laboratories, a flying field and a machine shop have been provided.

Airplane to Carry Twelve Tons.—Final tests have been made recently, under the United States naval supervision, of a power unit of three Liberty Airplane Motors geared to one 18-foot propeller by which it is hoped to establish an airplane cruising radius sufficient to control the ocean. It is claimed that an airplane of three or more units representing a total of 4,000 horsepower will have a cruising radius of 3,000 miles and a carrying capacity of twelve tons.

This is the first time that three Liberty motors have been geared to one propeller using a clutch system. The propeller turns at 800 R. P. M. and the motors at 1800 R. P. M. This is said to supply one of the missing elements needed to make practicable commercial aviation.

Radio Fog Signals.—The Bureau of Standards has developed a system of radio fog signals which has recently been installed, on a small scale, on the Pacific Coast. The device consists of a loop aerial about eight feet square with fifteen to twenty turns. These turns are in groups so that they may be connected in parallel or in series to gain the desired wave length. This loop is pivoted and is operated in the cabin by the pilot. A needle turns with the loop and is attached to a compass. The operation consists of revolving the loop until the signals are the faintest and then taking a reading on the compass for the loop needle then points to the source of signals. Each fog station is assigned a certain characteristic signal which identifies it to the pilot.

New Process in Iron Industry.—If reports received from Japan during the latter part of the summer are true, that country bids fair to take its place as one of the great iron producing nations of the world. Dr. Asobu Naito and Goro Matsukata, the report says, have made public a new and efficient method for the conversion of sand-iron or magnetic sand into a usable form of iron, the process consisting primarily in the combining of the raw material with coke, using gas flames, and extracting the iron from the ferro-coke obtained. Sand-iron is abundant in Japan.

Torpedo Fire Control Perfected.—A new system of torpedo fire control has been perfected by John Hays Hammond. Jr., by which the firing of torpedoes in a curved course is automatically controlled. By means of this system, it is said, a battleship or submarine could fire a torpedo at a target in any direction without changing the course of the vessel. Submarines equipped with the system could attack two targets at once.

Extensive Potash Beds have recently been reported in Texas by D. D. Christian, Field Geologist of the University of Texas. These deposits are found in Crane County in the western portion of the state. Mr. Christian is reported as saying: "I have tested some of the exposed salts and believe, from the samples, that I have found the greatest bed of potash in the world. I found two salts,—the white which tested from 2 to 3 per cent potash, and the red which tested about 16 per cent. It is my belief that in the section of Crane County which I examined; the potash will be found at about 1500 feet and the stratum will be from 100 to 200 feet in thickness, which would make it a greater find than any of the deposits in Germany or Alsace, the chief sources of supply for the world."

Can Control 1,000,000 Volts.—Engineers of the General Electric Company are reported to have succeeded recently in producing and controlling electricity at a potential of one million volts. The practical effect of the accomplishment will be far reaching, since commercial transmission of power at distances of 900 to 1,000 miles will be possible. At present, the greatest distance that power can be transmitted economically is 150 miles, in California. This record-breaking pressure was generated by transformer equipment designated along standard lines using a frequency of 60 cycles. Until recently, 220,000 was the record voltage.

New Parachute Supports Plane.—A parachute which, when opened, will support an airplane and prevent its crashing has been invented by Charles L. Newman. The attachment will be secured to the top and body of any monoplane, biplane or other machine. It is absolutely mechanical in its action. The release of a lever by a series of springs instantly opens and controls the parachute, whether the plane is falling, climbing or flying in a horizontal direction. Although the parachute is designed primarily as a safety device, it will be very useful in ordinary flying. When the aviator desires to make a landing, he merely releases the lever; and the plane gradually settles to earth at any desired speed.

Seaplane Climbs 20,000 Feet.—A new altitude record for seaplanes is claimed by a monoplane flying yacht, piloted by Commander David McCullough, U. S. N., and carrying three passengers, to an altitude of nearly four miles. Freezing temperature prevented the fliers, who were in summer attire, from going any higher.

A White Smoke Screen, dense and impenetrable, has recently been demonstrated at Camp Meade. This new invention, which is declared to produce smoke clouds having no injurious effect on persons passing through them, is being closely guarded by Army officials. When the smoke candles were lighted, instead of seeing black clouds rise as on the battlefields of France, the spectators were surprised by the dense, opaque white clouds which rose from the ground. The white candles are said to produce smoke in much greater quantities than the old style black candles.

Make Leather of War Explosives.—35,000,000 pounds of cordite have been bought by Henry Ford from the British Government to make artificial leather to be used on Ford cars. The cordite is to be made into artificial leather by a new process developed at the Ford Motor Company's engineering laboratories, which is declared to just about halve the cost of the leather. More than 25,000 square yards of artificial leather are now made daily at the Ford Highland Park plant. The process used at present requires large quantities of benzol, which is of high value as a motor fuel. The new process will release more than a million gallons of this commodity yearly for other purposes. The first shipment of the cordite was made in a dry state. Due to the bulkiness of the material, of which 4,000 pounds makes a full carload, in future shipments the material will be dissolved in ethyl acetate or a similar solvent which will produce a more compact mass for transportation.

Safety Council Meets.—How a billion dollars a year can be saved to the industries of this country by the prevention of the 20,000 deaths caused annually by industrial accidents, and the thousands upon thousands of injuries sustained by workers in industry, has been demonstrated at the Tenth Annual Congress of

the National Safety Council which has been held in the Massachusetts State House, Boston, September 26 to 30. A billion dollars a year is the cost of industrial accidents, the National Safety Council has shown, and it has been proved that these accidents can be prevented, and this sum saved through effective safety work. The problem of maintaining effective safety work during the present business depression and accomplishing this enormous saving, more important to industry than ever before during these times when every possible economy and retrenchment is being made, was one of the main topics set for discussion at the safety congress. The solution of this problem, it is expected, has been found at this conclave of the foremost safety leaders in the country.

Coincidentally with the safety congress a "no accident campaign" has been staged throughout the New England states. Industrial organizations all over this territory have conducted special drives on their properties to teach their employees more about safety.

Camden-Philadelphia Bridge.— Work has been started on the suspension bridge which is to connect Philadelphia and Camden, N. J. The bridge, which will span the Delaware River, is to be 1750 feet between towers. The main span of the Brooklyn Bridge is only 1596 feet and that of the Williamsburg Bridge is 1500 feet in length. The height proposed for the east main river tower is 380 feet above the river. The bridge in its entirety will exceed any other suspension bridge in the world by 150 feet, if the present plans are adhered to. The cost is estimated at $29,000,000, of which the state of Pennsylvania and the city of Philadelphia will each pay $8,273,000 and the state of New Jersey, $12,334,000. The engineer chosen to take charge of the undertaking is Ralph Modjeska, internationally known for his great number of successes in civil engineering. The engineers of the bridge commission have planned six roadways, four trolley lines (two for high-speed service), and two 10-foot walks for pedestrians. This is felt to be entirely adequate for all kinds of travel. The bridge will fill a great need which has been felt for many years for an adequate transportation link between the two cities. It is hoped that the bridge will be finished by 1926.

American Chemical Society Meets.— Chemists from all parts of the United States arrived in New York City on September 5th to attend what is believed to be the largest convocation of scientists ever held on the American continent. Their numbers were augmented at their fall meeting, which continued throughout the week, by the Society of Chemical Industry of Great Britain, which crossed into this country from Canada where it had just concluded its annual sessions. The overseas delegation, headed by Sir William J. Pope, is accompanied by several hundred of the Canadian members of the society.

The Chemists' Club, a ten-story structure at 50 East 41st Street, was the gathering point for laboratory experts from New York and neighboring cities. There they greeted old friends and held many informal reunions.

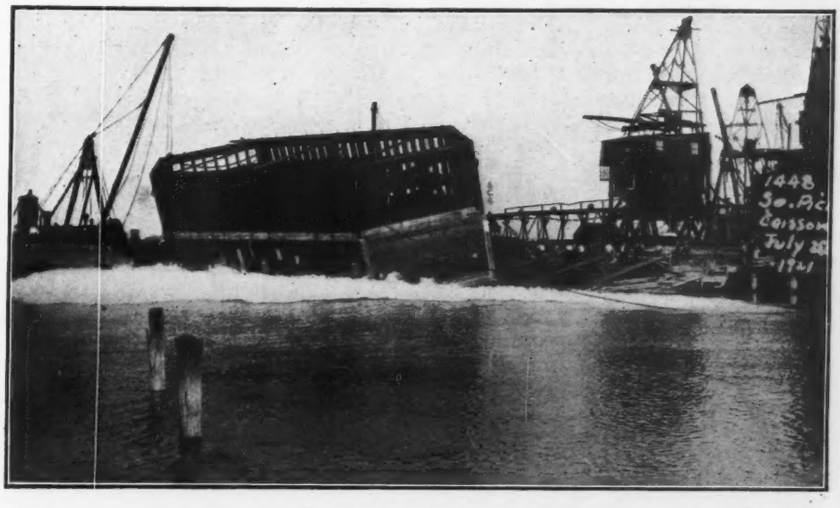
The first general meeting took place in the Gymnasium of Columbia University, and, in the afternoon, the sessions of the fifteen Divisions and Sections of the Society began. The International Meeting was assembled in the Great Hall of the College of the City of New York on Thursday afternoon.

Papers were prepared by Dr. L. H. Baekeland, Professor W. D. Bancroft of Cornell, Dr. Charles Baskerville, Sir William Pope, Dr. Joseph S. Hepburn of Philadelphia, Dr. Willis R. Whitney of General Electric Co., Dr. C. A. Browne of the New York Sugar Trade Laboratory, and many others.

The subjects covered included catalysis, juices of pitcher plants, mineral rubber, sugar, methods of saving contaminated crude oil, manufacture of artificial camphor, deleterious effect of glass on hydrogen peroxide, value of vitamines, and processes of filtration. Mr. W. D. Horne extolled sugar as a food, stating that more could be safely used by the average person than at present.

Process for Devulcanizing Rubber.—U. S. Patent No. 1,382,669. This patent has been granted to W. B. Pratt, and deals with a process for devulcanizing rubber by treatment with oxalic acid. It is claimed that the process removes the combined sulfur and leaves the recovered rubber in a state nearly the same as the original as far as its chemical and physical properties are concerned. Various dibasic organic acids have been tried, but oxalic seems to give the best results.

The Piscataqua River Bridge.—Work on the new $1,500,000 bridge across the Piscataqua River, which is to connect the city of Portsmouth, N. H., and Kittery, Maine, is now in full progress. The chief feature of the project is the swiftness of the current, which often exceeds seven miles an hour, and the 70-foot channel causing unusual engineering difficulties. For the piers of the bridge concrete caissons have been sunk, the men working under 35 pounds of air pressure. On top of the concrete caissons, granite piers will be erected, giving a height of ten feet above high water level. The bridge is to be 2000 feet long and the concrete in each pier weighs 1700 tons.



LAUNCHING A CAISSON OF THE PISCATAQUA BRIDGE
The caisson is then floated into place and sunk by filling it with concrete.

Fuel Oil in Great Britain.—It is reported from an American point of view that the most important result of the British coal strike is the permanent increase of the use of oil for fuel. It is stated that the fleet of Great Britain will in a very short time consist solely of oil-burning ships. Its coaling stations at home and abroad are to be turned into oil stations.

At a session of Parliament, Viscount Curzon asserted that the British destroyers could never have done their splendid work in the North Sea had it not been for the speed with which they could run in and refill with oil fuel.

Power stations for street railways, flour mills, margerine factories, electric lighting plants, railway locomotives large hotels, ferry boats and scores of other enterprises are converting their plants into oil burners and many of them declare that they will not go back to coal.

RECENT ENGINEERING DEVELOPMENTS

The Connecticut Light and Power Company is spending about $325,000 in New Britain by installing a new distributing station and increasing its Black Rock power house line potential from 33,000 to 66,000 volts. The current is carried by high tension wires over the hills from Waterbury and is used in industries and homes throughout this district.

Vegetable Oil pressed from peanuts, copra, and palm kernels, and cottonseed oil will be refined in a big plant which the Maryland Vegetable Oil Company has just completed in an industrial suburb near Baltimore. This is a $1,000,000 enterprise which will take over a factory equipped for the above-named production.

One Thousand Acres of mineral land near Smithfield, Ky., containing chiefly fluorspar and lead, will be developed by the Kentucky Fluorspar and Lead Company which has recently been organized. This company has leased the North American properties with a daily capacity of 150 tons and this will be doubled by the installation of new machinery.

Tampico, Mexico, will have a new water supply as soon as formal permission is granted by the civic authorities to lay pipes and mains in the city's streets, and construction will be begun immediately on the $8,000,000 project. The company is composed of American financial interests; and concessions have been obtained for piping the water to the various oil companies. The water will flow by gravity for 102 miles through a sixteen-inch pipe to a reservoir to be erected at sufficient height above the city.

Oil will soon be sought for in England as a recent report states that a company called the Fields of England, Limited, has been formed "to search and bore for petroleum" in the region about Newark and Nottinghamshire. Officials of the company are confident that the region is rich in oil deposits and that Great Britain can be made independent of the world for supplies of petroleum and its products. The government, however, is not so sure that petroleum is at all likely to be found.

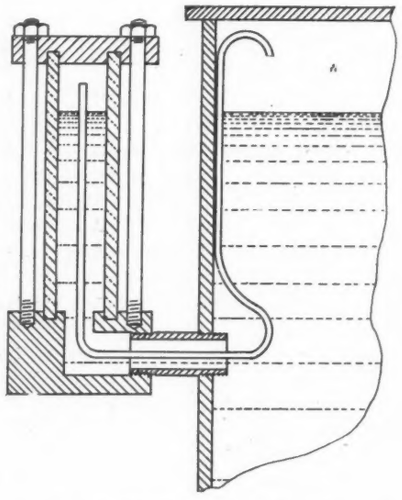
A New Electric power development plant which will have a capacity of 10,000 horsepower and will cost about $10,000,000 is to be erected at Great Falls on the Winnipeg River, 63 miles south of Winnipeg. Work on construction is already under way and the enterprise will be carried out under the charter of the Manitoba Power Company, Ltd.

A Coal Tar Dye plant in Australia will soon be in full operation according to an item recently received, as experts have proved 54 different shades and colors. The new firm has been established entirely with aid of Australian capital. It is expected that within twelve months the output will be 150 tons a year and that in two years the whole of Australia's requirements can be met. When in full working order, the plant will employ between 250 and 300 persons in addition to a highly trained staff of experts and chemists. Acid, basic, chrome, alizarine, nigrosine, and other types of dyes are to be made.

Improvement of the Port of Nanking, China, will soon be a reality, according to reports. It is proposed to erect at Nanking on an extensive water front a system of cranes, wharves, and railway facilities, with a view to enable deep-sea ships and others to load and discharge cargoes without loss of time. The Nanking harbor itself provides adequate berthing accommodations for big ships; but between it and the sea there are two shoals that, during the low-river season, affect its accessibility for deep-draught vessels. Steamers with a draught of 24 feet may at low river proceed to or leave Nanking for the sea, and at high river a maximum of 30 feet may be exceeded under favorable conditions; but the lack of a properly conserved approach seriously hampers at present its value as a commercial and shipping center.

IMPROVED GAUGE

U. S. Pat. No. 1,386,006



By Charles S. Lawson, '02.

This is a device intended to obviate the trouble which is encountered when air is compressed in the top of a tank, causing the gauge to show a higher level than really exists. By passing a small tube from the top of the tank up into the top of the gauge, the air pressures in the tank and the gauge are equalized and the gauge will always register correctly regardless of the pressures of the liquid or of the air.

The U. S. Public Health Service model health department in its annual report gives forth some interesting facts concerning the 516 acre reservation at Parryville, Md.

During the war, the reservation was used for housing the employes of a nitrate plant. The buildings included 200 cottages, two general stores, a schoolhouse, a theater, and several other buildings. The Public Health Service immediately set out to transform a group of the cottages into one hospital and also to build other cottages. Outside of the variable hospital quota, the reservation now has a population of about 839 persons about equally male and female with many children and few aged.

The birth rate was 39.33 on the reservation although only 24.39 in the state; the death rate was only 3.67. Careful work kept the communicable diseases low. Diphtheria was brought by some outside workmen. A test showed that one-third of the children in the school were susceptible to the disease but later only three remained susceptible. Between November, 1919, and 1920, the percentage of underweight was reduced from 42.7 to 13.8. The drinking water, which is drawn from the Susquehanna River, is naturally in bad condition and was excellently purified by several processes. Mosquitoes were practically exterminated by the usual methods, both to prevent malaria and to afford a needed relief.

Activity in Germany.—It appears that Germany is rapidly recovering from the effects of the war if a bulletin lately received from the Guaranty Trust Company can be believed.

The locomotive shops of the Krupp works are turning out locomotives at the rate of one a day. Waggons and motor-trucks are being turned out in large quantities. A surprisingly varied number of articles are manufactured at the Krupp works today, including adding-machines, cash-registers, textile and paper machinery, motion picture apparatus, dredges, floating docks and artificial teeth machinery, as well as the teeth themselves.

At Dusseldorf, the Rhein Metal Fabrik ranks as one of the first rolling stock industries in Germany. In less than a year, they have turned out 1,000 locomotives and 1,000 freight cars.

The shipbuilding industry is in a very strong position today in Germany. The companies in 1920 carved profits ranging from 50% to 100% more than in 1919, dividends averaging about 15%. There are at present 80 overseas companies operating out of Hamburg.

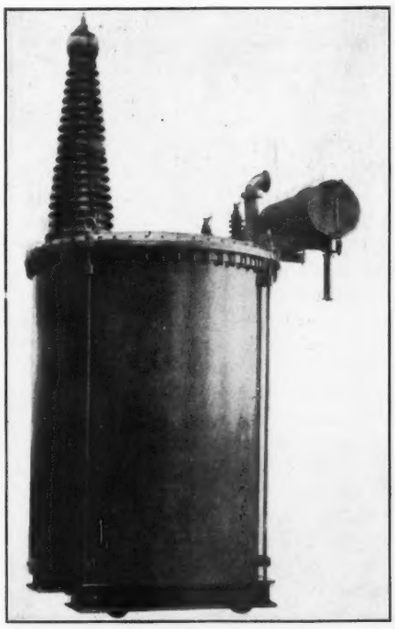
SUPER-POWER ZONE TRANSFORMERS

By WALTER S. MOODY '87

Engineer, Transformer Department, General Electric Co., Pittsfield, Mass.

The narrow zone extending from Washington on the South to Boston on the North, comprising about 2% of the total area of the Country, uses 25% of the total horse-power needed for the entire Country's total industrial and transportation requirements.

It is not surprising, therefore, that this territory should have been selected by a Government Commission to study the most effective means of conserving our natural resources. This Commission



STATIC TRANSFORMERS
A 220,000 volt 8333 kv-a transformer built for the American Gas & Electric Co., Windsor, W. Va.

has issued its first report and shows that by fully developing the hydroelectric power available and by building steam-electric plants having large units, economies can be effected whereby an annual saving of $300,000,000 a year can be made. To accomplish this saving it is necessary to tie together hydroelectric and steam-electric plants by a "super-power" line, and I wish therefore to say a few words concerning the static transformer so essential to the execution of this scheme.

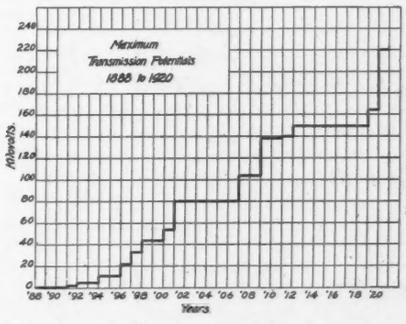
The static transformers and the necessary switching apparatus are the only parts of this system that must be distinctively in advance of what is already in use in our many large transmission systems.

The district, while approximately five hundred miles in length, is relatively very narrow, and the power houses, both steam and hydroelectric, must be quite generally distributed so that therefore it will not be necessary to transmit great blocks of power in any one direction, certainly not for more than two hundred and fifty miles. It has been agreed upon by the sponsors, as well as by the critics, of this scheme of power transmission, that the potential used should not be less than 200,000 to 250,000 volts.

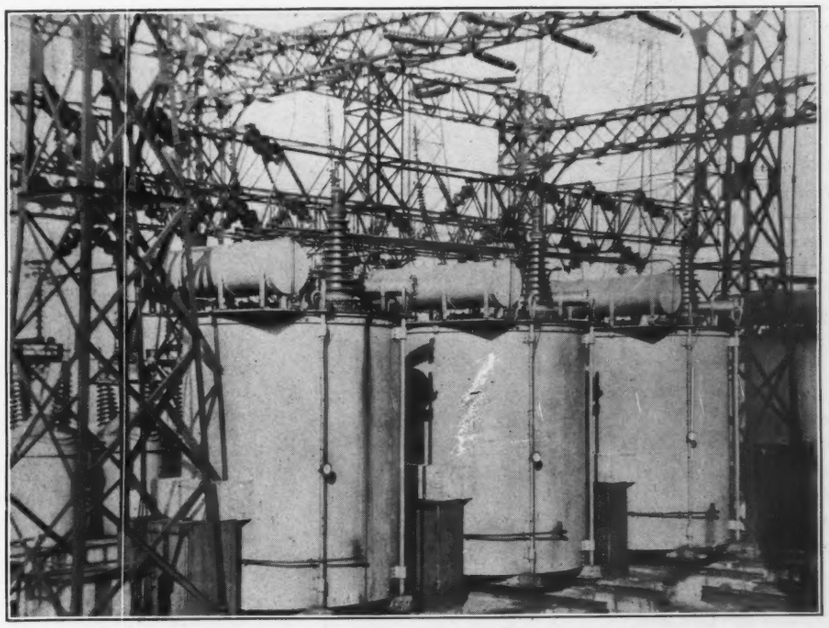
In confirmation of this, reference should be made to the graph which gives the dates at which various high potentials for power transmission were first put into practical service, and for which suitable satisfactory transformers were designed.

The writer first published this curve showing the record up to 1912, and pointed out at that time that the average advance had been at about 10,000 volts per year and predicted a continuation of at least this rate for some years to come. While abnormal conditions during the past five years temporarily delayed this progress rate somewhat, two large transmission systems have recently decided upon using 220,000 volts and the necessary static transformers have been ordered and are now being built. Apparently the lost time has been recovered and the old average rate of progress of approximately 10,000 volts per year has been re-established.

Much of the commercial success in the use of such high voltages will depend on the size of the units adopted. Experience has shown that there is a sharp upward turn in the cost per Kw at each voltage as the capacities decrease. Minimum sizes used on any voltage should ordinarily therefore be well above this critical size, and consequently 250,000 volt transformers should be very large units, say 10,000kw or more per phase.



In large industrial centers the power demands will be sufficient to require such units having such secondary pressures as are now used generally for distribution within each city, that is, 2400 volts to 6600 volts. Clearly, however, many of the large units connected to the super-power line must distribute their secondary output over considerable distance before the aggregate requirements are sufficient to absorb their capacity. Consequently, existing distributions at such voltages as 13,300, 22,000 and even 66,000 will not be generally superseded by the super-power line and its great transformers, but will continue to be necessary for the general economic distribution of the electric power.



SERIES OF STEP UP STATIC TRANSFORMERS
These 110,000 volt 10,000 kv-a transformers, transmit power from a "coal mouth" power house of 140,000 kv-a capacity to the same concern.

The Tech Engineering News

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COLLEGE LIFE

Greetings to all new Technology students! To the lowly Freshman, as well as to his more worldly brother, transferring from another college, we extend the hand of welcome and of friendship.

From the four corners of the civilized world you come, eager for knowledge. And what sort of knowledge is it that you expect to acquire here? You are entering the foremost engineering school in the country, and consequently are well aware that your future course of study is as perfect as time, money, and science can make it. The best current thought along technical lines is at your disposal. But the acquisition of technical knowledge alone should not be the sole aim of the student entering Technology. There is another function of college life which is equally important, and that is: the opportunity it affords of learning how to "get on" with one's fellow-men.

Co-operation is essential in all forms of industry, and the college-trained man has the advantage of being able to learn the secret before he enters the industrial or business world. He learns the secret of co-operation, not in the classroom, but on the athletic field, in the gymnasium, or in the office of his school paper, magazine, or other school activity. For only when a college man participates in one or more of the activities which go to make up "college life," does he really begin to appreciate the value of the co-operative spirit, the necessity of learning to work, not entirely for himself, but for the institution, be it school, college, or industrial organization, of which he is a part.

The curriculum of the Massachusetts Institute of Technology is reputed to be exceptionally difficult. And, indeed, those of us who are in a position to make comparisons must admit that this reputation is founded on fact. Tech students do have to work a little harder than students at similar institutions. Therefore, when we glance over the list of activities which are flourishing here at the Institute, we have just cause for pride. For Tech is represented in practically every form of collegiate activity: we have basketball, baseball, track, crew, tennis, hockey, boxing, wrestling, gym teams, an annual show, a year-book of the junior class, and a newspaper, not to mention the monthly technical magazine now in your hands. Taken together, these activities determine the real character of college life at Tech. For the greater the number of students who realize the value of participation in college activities, and who act accordingly, the greater will be the development of a spirit of fellowship and of loyalty to our Alma Mater, and the less justification will there be for likening the Institute to a great "educational factory," turning out scores of men well versed in the technical, but woefully lacking in the human side of engineering.

Participation in activities, in addition to carrying a heavy schedule of study, does require quite a little extra effort. But it is a well-known fact that the more a man has to do, the easier it is to get things done. We find that, under pressure, we can do twice as much work in a given time as when there is no hurry about it. Thus we learn to concentrate and to economize our time, which is necessary for our survival in the keen competition of the modern business world. If in the future, then, when we groan under academic burdens, and think that life at "the glorious Institute" is not as glorious as it might be, let us think of our fellow-students who are going out for athletics and other activities, in addition to their regular work, and who—which is more important—are getting away with it! Let us not allow our education to become one-sided; rather, let us lend our whole-souled support to those activities which tend to broaden our characters, to increase our understanding and respect for our fellow-students, and to make our college life at Technology truly democratic and typical of the great republic in which we live.

THE OTHER SIDE OF ENGINEERING

To the freshman as he first makes his way about the realm of the White City, the Institute seems very much like an inhuman machine for making an emulsion of those non-miscible fluids, manhood and mathematics. To the novice at Tech it seems as if his entire future were to be devoted to the mastering and use of calculus, to him engineering appears not as a means of serving humanity but as a field wherein to apply his painfully acquired knowledge of mathematics. He is a young man when he enters the Institute; he hopes to be an engineer when he leaves.

In the first crowding rush of technical studies it is hard to get away from the idea that the Institute is a place where young men are changed into engineers. The engineer seems to the freshman such a hopelessly technical person that he finds it difficult to look upon his Tech course as one of development instead of one of mere metamorphosis. He is inclined to think that he must throw aside all his previous concepts, all his thoughts and interests which are unrelated to his chosen profession, and devote himself wholly to technical matters.

In this, however, he is making a very fundamental mistake. In his Institute work, as in fact is the case with all his engineering activity, he must keep all the ideas which he has held and get more also. He must become an engineer but he can never do it at the expense of throwing away his human interests. The Tech man, steeped though he may appear to be in derivatives, is after all a man and it would be the height of folly for him to let mathematics master him instead of dominating it and making it his tool. Get the math cold by all means; that is vital. But don't neglect those courses in history and the mother tongue.

THE DISARMAMENT CONFERENCE

One of the greatest disappointments which the modern political idealists have suffered in the past decade is the defeat of the plans for universal peace which seemed so possible of fulfilment at the Versailles Conference. Many believed that the world struggle had at last convinced civilized humanity that war is inconsistent with progress and humane idealism. There were those who hoped that the time had come when men could apply other means than wholesale murder for the settlement of international

difficulties; and there were many service men who were determined that in future days their sons should not be called upon to make the sacrifice which had been demanded of them.

The covenant of the League of Nations with the United States as an active member might have provided a safeguard against future wars. Our country, however, did not see fit to join the League of Nations; and the league as it stands is not adequately provided with any means of enforcing its rulings. So far as fulfilling the hope of the idealists, so far as being a means of preventing future wars, the peace conference was a failure of the most deplorable kind. From it we can hope for absolutely nothing in the direction of a permanent world peace.

The American people, however, seem to have had their fill of wars and are genuinely concerned with the problem of abolishing them. They are divided in their regret and satisfaction at our having declined to adhere to the covenant, but they are united in their determination to end permanently all war. With this end in view President Harding has called the nations of the world to sit at a conference to discuss international disarmament. Bloody Mike, the only son of Mars, is to be tried at that conference and it is difficult to conceive of a jury who would acquit the robber of the world's resources and the slayer of its sons.

No, we cannot conceive of a jury's acquitting War, but there is every possibility of disagreement and failure to reach a decision. Unless the delegates come to the conference sincerely determined to take the first step toward the abolition of all wars, the conference which the president has called will be as dismal a failure as was that at Versailles. Let us hope that the brightest hopes held out for the outcome of this conference may be fulfilled!

SCOFFERS

"It can't be done."

How often are these words spoken when knotty problems or difficult projects are under consideration! It seems that the world is full of people who are ever ready with these cheery words whenever an innovation or an original plan are proposed. Every great invention has been born in the face of such disbelief. Fulton, the Wrights, and Bell are a few of the host of men who have ploughed their way to brilliant achievement, despite the jeers of scoffers. Every man of science faces the same difficulty. Somehow the world at large seems unwilling to have the existing order of things change. In the popular mind, an old adage appears to carry more conviction than a sound scientific law. Arthur D. Little has recently proved the fallacy of one of our grandfather's assertions. He has made a purse out of a sow's ear even though it has always been said that "it can't be done."

This accomplishment in itself is perhaps not especially noteworthy. Chemists have long wrought marvels in their world of test tubes and retorts. But in Little's success, there should be an object lesson for those of us who are guilty of our grandfather's failings. We should never say that a thing "can't be done." If we do, we are betraying our ignorance and giving positive proof that we have not acquired enthusiasm. Moreover, we are hurling obstacles into the path of a fellow worker whose progress may be greatly hindered or even checked altogether thereby.

There is no place in such an institution as Tech for men who are ever throwing cold water. Nothing is impossible until science has proved it to be so. Since science is mighty slow in revealing many of her secrets, we should be very cautious in taking the over-skeptical attitude.

The safest course is to suspend judgment until all the facts are in our hands. In the meantime, our voiced opinion should be encouraging. "It may be possible" is much better than "it can't be done."

THE TECHNOLOGY IDEA OF TECHNICAL EDUCATION

What is behind the courses of study laid down at the Institute is, to the average undergraduate, a seemingly unfathomable mystery. He is unable to see why certain courses are included, to the exclusion of others, why an engineer must study English and History, and why a Freshman must limber his joints at "monkey drill." He is liable to come to the conclusion that the courses of study are in their present form merely in conformity to habit and custom. But there is something back of it all known as the Technology Idea of Technical Education. Ask an Institute professor just what the Idea is, and you'll see him for once at a loss for words. He knows what it is, but he's never told anyone; he knows better the type of graduate it is designed to produce, and that is what he'll tell you. But perhaps the Idea can be expressed, after all.

The Idea assumes that those subject to it have enthusiasm and power of application, and that they have a well developed and properly restrained imagination. The latter, while not essential for an engineer, is essential for a good engineer.

A main endeavor of the Technology Idea is to develop analytical and creative minds, to give the students training in solving scientific problems. It is not expected to produce finished engineers in a four year course, as that is a lifelong problem, but it is expected to give those capable of receiving it a greater capacity for becoming creative and leading engineers, whose final accomplishments may be obtained through experience and practice.

All the above implies the imparting of a great deal of information, but the limitations of the human memory are such that what is to be memorized must be very carefully selected with reference to its probable usefulness. In other words one must develop a good "forgettory." The Idea must develop men who have a deep knowledge of principles and fundamental facts and who know where to look for and find any further information they may need. Accordingly, information courses have little place in the schedules. They are present only to a limited extent, sometimes to secure point of view and sometimes as a diluent in a course otherwise too severe.

Great facility in manipulation, either with tools or with processes, is a secondary aim, since this can mostly be acquired to the best advantage later in practice. Nevertheless a very considerable measure of experience and of facility do come about as a valuable by-product in teaching theory in connection with its applications, and this is one of the many things that distinguishes Technology.

Another aim, which is increasing in importance, is the development of the social and economic sides of the engineer. This has been necessitated by the increasing part which the engineer is taking in municipal and national matters and by the desire to produce not only plant executives, but business executives as well, who shall be capable of directing and controlling plant, laboratory, and office.

However, all the above may be stated concisely in the following specifications, in descending order of importance, for a successful engineer, in accordance with which, Institute courses are arranged: Character, Intellect, Scientific Foundation, Knowledge of Men, and Knowledge of Engineering.

RECOMMENDED ARTICLES

"The Distance Compass," Aerial Age Weekly, August 29, 1921.

"Motorizing Our Philippine Isles," American Industries, September, 1921.

"The Panama Canal, A Natural Asset," American Industries, June, 1921.

"The Magnetic Electron," Journal of the Franklin Institute, August, 1921.

"The Detection of Accelerators," Rubber Age, August 25, 1921.

"Application of Radio Communication to Public Utility Purposes," Electric Traction, August 15, 1921.

"Power Plant Evolution," Mechanical Engineering, September, 1921.

UNDEVELOPED SOURCES OF ENERGY

By DR. A. D. LITTLE '85

President of the Alumni Association

The amount of food consumed daily by the average New Yorker has about the same energy content as one-half pound of coal, and, like the rest of us, he is commonly unwilling to convert all that energy into useful work. Properly applied, the proportion so utilized in brain power may suffice to run a railroad or dominate an industry. In less favored sections of the country, a few men, by utilizing gravity, may launch a warship.

We are cognizant, however, of sources of energy inconceivably greater than any possible requirement of the human race. There is to be considered, first of all, the radiant energy of the sun, of which Lodge assures us the earth receives only one one-hundred-and-fifty-millionth part. It seems too little to talk about. It is only three small calories per minute per square centimeter of the earth's surface. But Ciamician has calculated that a surface of only 10,000 square kilometers receives in a year, assuming only six hours as the effective day, a quantity of heat that corresponds to that produced by the burning of 3650 million tons of coal. That is considerably more than double the entire world production. The desert of Sahara, with its 6,000,000 square kilometers of area, receives daily solar energy equivalent to that of six billion tons of coal. The world awaits the genius who will convert radiant energy into electric current. Of that minute portion of the solar energy received by the earth, only about 1/300 part is stored up by the plants. They, nevertheless, produce annually, according to Ciamician, 32 billion tons of vegetable matter, which, if burnt, would develop a quantity of heat equal to that derived from the combustion of 18 billion tons of coal.

The energy of the earth's rotation is a matter for the astronomers. It is undoubtedly of the order of magnitude to which they are accustomed, but by which chemists and others are confounded. It has been thus far utilized only by Mr. Sperry in his applications of the gyroscope. Somewhat similarly, we may recall, the Greeks rubbed a piece of amber and picked up a feather. The other developments of electricity came a thousand years later.

In a few exceptionally favorable locations, it is feasible to utilize a trivial fraction of the total energy of the tides. The intermittent flow, the varying head, and other special conditions involved in the problem are likely to hold the development of tidal power within closely restricted limits. It is, nevertheless, reported that two significant developments are now under consideration: one, by the French Government, at St. Malo, where the picturesque River Rance finds outlet in the quaint old harbor, where the tide rises thirty feet; the other, at the mouth of the Severn River, by the British Ministry of Transport. Here, again, the tidal range is thirty feet. The proposal involves throwing a dam three and a half miles long across the Severn estuary and the installation of hydroelectric turbines with an integrated capacity of 1,000,000 horse-power, but an available output on the continuous basis of only 437,000 horse-power. The excess capacity will be utilized in pumping water to a high-level reservoir for delivery to turbines during the hours of enforced idleness of the turbine plant in the main dam. The studies by Norman Davey of the available tidal power of the British Isles lead him to fix the total at a little over 2¼ million horse-power in terms of average continuous power. Since, however, it is, in fact, available only as intermittent power, much larger installations are required to maintain the average rate. Since the capital charges against hydroelectric power are normally high, this requirement would seem to render them excessive in case of tidal power.

> The transformation of mechanical energy into electrical energy and vice versa are common phenomena. Does it not seem possible that in the future some genius may solve the great problem of the transformation of light energy into mechanical or elctric energy? In his article Dr. Little considers this as well as the probability of our ever being able to utilize the tides, internal energy of the earth, astrononomical energy and other unending sources of energy which surround us in our every day life but which are of such little value to us now.

To those who have seen the pictures of the Valley of a Thousand Smokes in Alaska or who have witnessed a volcano in eruption there is no need to attempt to give quantitative expression to the forces responsible for the imposing spectacle. It seems improbable that the vast store of energy existent as the earth's internal heat will ever be available to us in any substantial measure. A recent news item has, however, referred to a 30,000 h. p. steam-turbine installation in Italy, which derives its energy from steam issuing from vents in the side of a volcano.

Of extraordinary interest to chemists are the accumulating evidences of inconceivably great amounts of kinetic energy possessed not only by radium, but by ordinary matter as the constitutional energy of its atoms. Fortunately for sciences, some atoms—those of the radioactive elements—are surcharged with energy. They lose some of it spontaneously, thereby setting up the remarkable phenomena which drew attention to the facts, with which we are all familiar, and caused us to revise our fundamental conceptions of the constitution of matter and the interrelations of the elements. We now recognize that concealed in matter of every kind are stores of energy immensely greater than those derived from chemical reactions or concerned with any of the forces with which we commonly deal. We recognize them as of an altogether higher order of intensity and magnitude than the energy derived from burning coal or liberated from the most powerful explosive. So stupendous and far-reaching are the possibilities contained in the suggestion that we may ultimately be able, without destruction, to draw upon this energy supply that Rutherford has said, "The human race may date its development from the discovery of a method of utilizing atomic energy." At this stage of our social development, with its possibilities of international friction and misunderstanding, it is perhaps fortunate for civilization and ourselves that this discovery has not yet been made. We have still far to go before we adequately utilize the energy reserves already at our command.

Our civilization is based on coal. It will be based on coal for many generations to come, in spite of tendencies which seem to imply that the burden is shifting to petroleum. However far the transfer may proceed, the carrying power of petroleum is temporary and likely to be brief.

Including 3,000,000 units of lignite, the world's total coal reserves in units of one million tons are about 7,400,000 units, of which over 5,000,000 are in North America, 1,280,000 in Asia, 784,000 in Europe. These estimates of the world's reserves undoubtedly include much very inferior coal and much that cannot be mined without great difficulty by reason of its depth or the manner of its occurrence. There is, therefore, a considerable divergence among authorities in their classification into actual, probable, and possible reserve in the various regions of the world. The broad facts are, however, well established and are sufficient for our present purpose. The actual reserve, or coal of which there is definite knowledge, is little more than half the total estimated, and of this actual reserve about four-fifths is in the United States. The production and use of coal in the various countries does not, however, stand in any direct relationship to their reserves. The world's production in 1913 was 1,478,000,000 short tons, of which the United States contributed about 570 million, Great Britain, 321, and Germany, 305 million. Japan, with total reserves below 8,000 mil-

lion tons and a relatively small production, is a large exporter of coal. In Great Britain the high quality of the coal and the short average haul of only 20 miles to the coast has not only greatly encouraged the extension of British shipping, but has established the world's greatest export trade in coal. Considered economically and in view of England's seriously depleted coal reserves, this trade begins to assume the character of a transfusion of blood, admirable for the receiver, but weakening to the contributor.

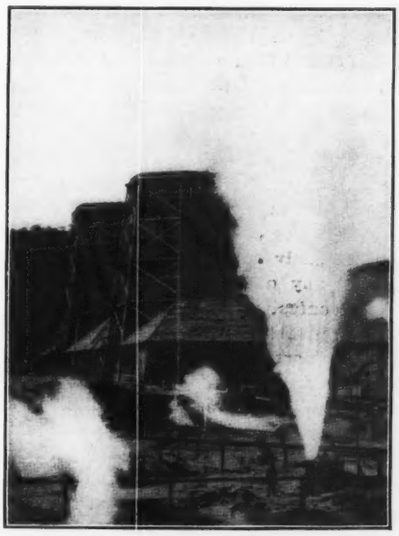
Natural gas has been aptly designated "Nature's bonus to America." One-tenth of our population are wholly dependent upon it for lighting, cooking, and heating, but even so its larger uses are industrial. About two-thirds of the total output is burned in manufacturing plants under boilers or utilized in metallurgical operations, cement kilns, glass-making and pottery furnaces. Much of the cheaper gas is burned for carbon black. It is a waning resource. It has been wasted shamefully. In volume waste has run parallel with use and often outstripped it. In 1917 we used about 800 billion cubic feet, which was three-fourths of all gas sold in the world. We also wasted 800 billion cubic feet and with it much gasoline. We are not wasting quite as effectively now. The supply is running out, and our 1920 production was below 650 billion.

The same phrase applies with equal force to our development of petroleum, of which the United States now produces about 70% of the world's supply. As in the case of natural gas our reserves are rapidly nearing depletion and can hardly maintain our present rate of production for more than twenty years. We have wasted more than we have used. Our 260,000 producing wells leave more than half the oil under ground, and less than half of what they take out reaches the pipe line. Then we burn half of that as a substitute for coal, of which we have 6000 years' supply. We need an intelligent economic policy in these United States, and power to enforce it. The basic cause of this orgy of waste and the unrestrained production that makes it cheaper to burn oil than coal is the small individual holding. The owner must hustle to get his oil out, or it will be taken by others from under his feet.

There are about 8,500,000 motor vehicles in this country, representing at a conservative estimate a generating capacity in gasoline engines of 212,000,000 h. p. One manufacturer is adding to this an integrated capacity of 94,000 h. p. a day. Requa estimates our gasoline demand in 1930 at 300,000,000 barrels. Meanwhile, it looks as though the old firm of Demand and Supply might be dissolved.

Ciamician has estimated that the solar energy stored by plants produces 32 billion tons of vegetable matter annually, equivalent in heating power to 18 billion tons of coal. The costs of collection deprive these figures of much of their significance, but they point, none the less, to striking possibilities in the production of power alcohol. Meanwhile, our peat supply is building up. But peat, though already available in vast amount, must be classed with oil-shale as an energy reserve, valuable when needed.

The rising price of coal has tended to focus attention upon water power, although this tendency has been marked and of more stimulative effect abroad



A POWERFUL "SOFFIONE"

At Larderello, Italy, the energy of volcanic steam is being utilized, with the aid of steam turbines, to develop over 3,000 kw.

than here. The water-power resources of the United States are sufficient to operate every factory and light every building in the country, but their general development is inhibited by the cost of money for enterprises in which bond interest constitutes 77% of operating costs. In recent years only about 10% of our power expansion has been deflected to water power, though from 100 to 200 million horse-power, well-distributed geographically, await development, of which 50 million is capable of use without the creation of unduly expansive storage. General development is likely to be deferred until the best of our coal and oil is gone. Meantime, very important hydroelectric developments are proposed or under way in Europe.

Since coal must remain for generations our chief energy resource the line of progress parallels the better utilization of coal. Here a vast deal may be accomplished. Coal should be better cleaned. It should be fired under close scientific control. Heat losses should be minimized; power generation should be centralized, and small plants encouraged to buy their power. Inferior fuels should be utilized as powdered coal. The bee-hive oven should go. Coal mining should be integrated. We may expect notable developments in the processing of coal and the more effective utilization of coal products.

As the cost of human energy goes up that of the energy derived from Nature must come down if social progress is to be maintained. Energy is the economic support of progress. If that support is to be adequately afforded, we must have cheap energy. We can have cheap energy by better administration, better development, better application. With cheap energy we need common-carrier transmission lines, like those contemplated by the Superpower Survey, to make that energy available over wide districts.

The disastrous explosion which on March 19th wrecked the $4,000,000 reinforced concrete grain elevator of the Armour Grain Co., of South Chicago, Ill., was caused by the ignition by some small spark of quantities of grain dust present in the atmosphere of the elevator, according to investigations carried out by the U. S. Department of Agriculture. The structure was the largest of its kind in the world, and represented the very last word in grain elevator construction. Embodying the most modern engineering principles of design, constructed throughout of fire resistive materials, and operated on a higher safety standard than the average terminal grain plant, it was literally torn in pieces, the roof and upper walls being demolished, and thousands of bushels of grain being poured into the Calumet River. Six American workmen, engaged in cleaning one of the corn driers, were killed.

The engineers investigating the wreck found conditions similar to those which caused a large number of explosions in various parts of the country a year or two ago. Demonstrations with a model elevator following the latter showed that irresistible explosions can be caused by the ignition of dust mixed with air in certain proportions. Whether it is possible to construct a grain elevator or other dust-susceptible buildings with ledges, trusses and other horizontal portions so sloped that they would not give lodgement to dust, is a question which engineers must determine. The present agricultural appropriation act, effective July 1st, contains an item of $25,000 for resumption of dust explosion investigation work.

That heat, light, and moisture weaken cloth of any kind has been shown conclusively by Leo Vignon in his experiments recently in France. He found also that silk has far higher resistant powers than linen both as regards the action of the weather and that of ultra violet rays.—(Literary Digest)

MUNICIPAL FIRE ALARM SERVICE

(*Continued from Page 82*)

phere, exposure to gases and to the shocks and vibration resulting from heavy traffic must not impair the operability of such systems. To meet such exacting conditions, features of design and construction are adopted which relate to so many different matters that a complete recital of them would be both tedious and, in the absence of most elaborate explanations, serve more to confuse than to enlighten; yet each is highly important, and many are absolutely essential to reliability under all service conditions.

The following examples will serve to illustrate some of the more readily described problems, although they do not afford any indication of the number of such problems nor of the intricacy of many of them.

The manual operation necessary to cause the transmission of an alarm should be so simplified that no blunder, whether due to malice or inexperience of a person attempting to send an alarm, can result in the transmission of an incorrect signal, and so as to minimize the possibility of an attempt to send an alarm proving ineffectual. To these ends,—each fire alarm box is provided with a transmitting clockwork mechanism inclosed in an iron case, through a small opening in which the starting handle projects. No other parts project from this case, so that a comparatively slight movement of the one projecting part which is within the reach of any person having occasion to send an alarm, in the only direction in which it is movable, will set the mechanism in motion and assure the ultimate transmission of the signal, regardless of whether the part is held after having been so moved, is promptly released (as it should be), or is repeatedly and violently moved up and down. This feature is frequently referred to as "local non-interference" or "non-interference pull."

Inasmuch as it has been found that persons having occasion to send an alarm of fire are, almost invariably, too excited and confused to either dependably or intelligently act upon any warning signal which might be provided to give notice when the circuit is already in use,—such warning signals are not relied upon, and are not even supplied in modern boxes; but, instead, so-called "distance non-interference" mechanism is provided in each box to prevent circuit breaks being caused by that box, which are untimely with reference to the signal of any other box; thus preventing the confusion called "interference" which would otherwise develop should two or more boxes be started so as to act concurrently to transmit their alarms over the same circuit or circuits.

Inasmuch as it is unsafe to assume (other than, perhaps, in very small communities) that the alarm from any given box does not demand individual response thereto, even if an alarm is in course of transmission from some other and perhaps distantly situated box,—and in view of the further fact that there is little likelihood that a box which has been pulled while the circuit or system in which it is connected is occupied with the transmission of the alarm from some other box will be promptly pulled again, manually, when its circuit is free to receive its alarm,—it is evident that provision should be made whereby, when any box has been once manually actuated, it will continue to be active until it has effected the transmission of its intended alarm. Such a function is called "succession."

Boxes of the type commonly referred to as "perfect non-interference and succession" have mechanism, supplemental to that affording local non-interference, whereby the following results are obtained:—

No box will break the line as a result of any attempt made during a broken line interval which commenced before the attempt was made.

If several boxes break simultaneously, all except one will relinquish the line before an improper break occurs.

If any box relinquishes the line in favor of any other box which started previously to or simultaneously therewith, such box will refrain from thereafter breaking the line until the previously or simultaneously starting box has ceased transmitting.

The mechanism by means of which these results are accomplished is surprisingly simple and rugged in character, but requires, for its dependability, a precision of form and assembly which is not elsewhere found in commercial apparatus, other than in the most expensive scientific instruments.

All mechanism is so constructed as to provide a very large factor of safety; gears and levers being very much heavier than those provided in clock trains or other mechanism having a driving spring of anywhere near corresponding power, and all parts are accurately machined so as to assure a correct distribution of weight and such spacings as to exactly maintain the most dependable relationships between co-operating surfaces. In order to maintain integrity of machined surfaces, they are so treated as to protect them from corrosion and rust; and the form of protection is varied, for different surfaces, so that those which act in rubbing relations (such as gear teeth and shaft pivots) will be protected from coatings, such as lacquer, which might roll up and impede or interrupt intended action.

As already pointed out, it is important that all adjustments shall be of a permanent character, holding means being provided for adjustable parts wherever there would otherwise be opportunity for adjustments to change in response to vibration or climatic changes. Even the winding of the main-spring must be guarded to prevent injury to the spring

(*Continued on Page 100*)

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"FEELING blue?" asked the grad of four months' standing. "Everything's new and strange, isn't it? I myself know how that feels. At my job in the electrical works I'm a freshman over again—like you, a little frog in a big puddle.

"Not so easy, getting on to the ropes. Makes a fellow impatient for the time to pass. You're anxious to get the upper hand over your work, you want to make the team, you want to clean up in general.

"Well, it can't be done all at once. But getting off to a good start is half the game. Just pick out what you want the most and go after it hard.

"Tackle your obstacles—pretty tough now but after you've downed these you'll find the going easier. Look on each week as a yard line you are crossing.

"See how every gain, every problem you get the best of, is important—not for itself but because it is a necessary part of the bigger drive that gets you down the field. Just keep plugging, with your heart in the game, and you'll make your touchdown.

"Pretty good advice, isn't it? Guess I'll take it myself!"

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COMMERCIAL DEHYDRATION

By PROF. S. C. PRESCOTT '94

Professor of Industrial Biology, Massachusetts Institute of Technology

The process of dehydration seems destined to be the next big development in food industries in the United States. Many dehydrated food products have always been staples in American produce markets, but until very recently the production of dehydrated vegetable products of high grade has not been possible, and public demand for the medium or semi-inferior grades which have been produced has been light indeed. Abroad, dehydrated methods have been applied to various staple vegetables with greater success. War-time demands for large quantities of vegetable foods in light, compact, and safe-keeping form immensely accelerated government and university research work in dehydration methods and certain definite improvements have been obtained. By virtue of dehydration, equivalent food values of bulky vegetable materials can be packed in one-tenth of the space and transported with one-tenth of the weight of the un-dried materials. This margin of saving in packing and transporting, coupled with the surety of "keeping" of dehydrated vegetable products, will surely guarantee the rapid development of commercial dehydration.

The basic principle of dehydration is extremely simple, implying only the removal of the water contained in and between the cells of the food substance, with the result that the stored food materials, salts, etc., are concentrated in direct ratio to the water evaporated. Since only replaceable water is taken away, the nutritional value of the food is not diminished. For the finest grades of dried products the rate of evaporation should be such as to bring about the dehydration of the cell-contents without rupturing the cell-walls. If the dehydrating process is applied while the vegetables are still in a state of absolute freshness, the special flavor-giving compounds are conserved intact.

Dehydration methods have been perfected for the dehydration of all common vegetables, including green beans, cabbage, carrots, green corn, lettuce, green peas, white potatoes, sweet potatoes, spinach, tomatoes, and turnips. The actual reduction in weight depends of course upon the degree of dehydration effected, but varies from 75-90%, with a corresponding decrease in bulk. Formerly, it was impossible to preserve the flavor of the vegetable beyond a certain small degree of dehydration and at the same time to preserve an attractive appearance. Particularly was it difficult to prevent the "blackening" of white potatoes, and the use of sulphur was common in order to preserve their appearance, with consequent loss of appetizing flavor. We can now prepare white potatoes economically which for purposes of boiling or frying are indistinguishable from the undehydrated product.

Two general methods have been employed for commercial practice, viz.: The so-called Tunnel and Kiln Processes. Vacuum machines and other specially designed chambers in which the air is absolutely conditioned have been employed to a lesser degree, but promise to become the prevalent type of dehydrating apparatus in the future. In any system the vegetables are carefully cleaned and prepared by paring and slicing. It is necessary to control both the temperature and the humidity of the air-draft over the racks between certain narrow limits and to vary them according to the stage of dehydration. If the drying is begun at too high a temperature or goes on too rapidly the water-absorbing quality of the product is impaired. If the initial temperature is too high, scalding or scorching results. The proper principle of dehydration is to subject the fresh material to air of relatively low temperature (100-120 degrees C) and relatively high humidity, and to bring it gradually to a high temperature and low humidity. In the tunnel system, racks containing the vegetables are run into the "tunnels" at one end on cars, and the product in dried form removed from the other end. Where kilns are used the vegetables to be dried are spread over the floor of the kiln to a depth of four to six inches and hot air forced up through the layer and out of the kiln through a ventilator in the roof. In the vacuum process, steam heating of the racks is employed and evaporation effected at a relatively low temperature by the maintenance of a high vacuum within the drying chamber.

The keeping qualities of dehydrated food-stuffs are limited only by the lack of observance of care in preparation and storage. An extensive investigation of the keeping quality under different conditions of storage and in different types of containers has been made under the writer's direction. This has shown that with good products in suitable containers there is no deterioration even when the foods are stored for months under the most adverse conditions of temperature and moisture. Paraffined barrels of dried vegetables were taken from storage after fifteen years with their original qualities practically unimpaired.

GENERAL ELECTRIC STUDENT COURSE

By JOHN L. KERR '13

Commercial Engineer, Turbine Sales Department, General Electric Co., West Lynn, Mass.

The General Electric Company offers, at Schenectady and Lynn, student engineering courses operated on principles which are arranged to result in the greatest advantage to both the students and the company.

The majority of men when they leave college have not definitely planned to enter any special field and, through some cause or other, afterward find themselves out of the field wherein they could accomplish the most. On account of the above, the Testing Department of the General Electric Company is planned so that students are transferred from one section to another at their option. This plan works out as follows:

The testing of each type or class of apparatus is arranged in sections and a man after entering a section remains a predetermined length of time, after which he applies for a transfer to any other section he chooses.

Since apparatus for practically every electrical field known is manufactured by the General Electric Company, any one can realize what an unlimited storehouse of knowledge and experience is available to be drawn from by the student; and, moreover, the branch from which he draws it is chosen by him. This fact is an item of much moment.

Usually for the first few months, a student looks for and gets general experience both in manufacturing and testing different classes of machinery. At the end of this time, most men have an idea as to what particular field is of greatest interest to them, and they can choose the building and testing of the apparatus involved.

One outstanding feature of the course is that every one connected with the testing of machinery is a college man, there being no regular so-called testers. This is very desirable from the men's point of view, inasmuch as it means that students have the entire responsibility for operating the apparatus. When a machine is set up, it is turned over to some one man, who takes charge of it, and he never has men to help him. He is given a list of the tests desired and has to assemble all of his testing apparatus, such as cables, rheostats, instruments, testing tables, etc., and make his own connections. After

(Continued on Page 98)

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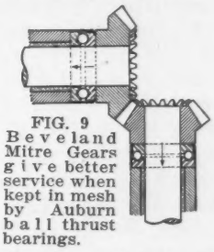

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NEW FISHERIES ENGINEERING COURSE

(*Continued from Page 76*)

publicity, marketing, sales management, and the many other phases of activity necessary in a thoroughly organized industry.

Finally, a fisheries engineer should know how to supervise the health of his employes, safeguard his products, maintain his plant in a clean and sanitary condition, and advise in matters of personal health habits. A group of subjects bearing on public and personal hygiene and plant sanitation equips him for this phase of his future work.

The Course in Fisheries Engineering as it has been thus briefly and roughly characterized is seen to be a composite of subjects in the Departments of Biology, Mechanical Engineering, Chemistry and Engineering Administration. It is comparable with the other four year courses offered at the Institute and leading to the degree of Bachelor of Science. While the largest percentage of work will be in the Department of Biology and Public Health, the engineering subjects will be taught in the Department of Mechanical Engineering, and the business subjects in the Department of Engineering Administration. The work of the first two years is largely in fundamental general subjects, while that of the last two years is largely devoted to specialized studies particularly applicable to the Fisheries Industry. The requirements for admission to the course are the same as for the other professional courses, and it is regarded that the satisfactory completion of the prescribed course of study stamps the man with a professional attainment of as high standard as the training in the older courses such as Civil or Mechanical Engineering or Chemistry or Architecture.

It is worth noting that what applies to the fishery industry is equally applicable to the other food industries. We might properly expand the course and call it Food Engineering and this may later be done. It is only necessary to modify in some degree the subject matter of a few courses to provide a training that might find application in meat packing, or in the canning and drying of vegetables and fruits or in other food industries. All types of processes of food preparation and conservation have progressed from the simple domestic or home industry, through the small factory stage, until today they are developments of large units, and have become the focus for a special type of engineer who can visualize and can realize production on a large scale. It is a safe prophecy that the term "food engineer" will be common within five years. We have "refrigeration engineers" already.

The course of study which has been outlined has received the hearty approval of the industry, the trade journals, Chambers of Commerce and representatives in Congress, the U. S. Bureau of Fisheries, and the Commissioner and Deputy Commissioner have kindly offered the heartiest co-operation in every possible way. Already one investigator has been detailed to work in the Biological Department on a special problem of much importance, and others are likely to be assigned here as rapidly as they can be trained. It has also received the support of the state conservation commission, of the Federal Department of Agriculture through the Bureau of Chemistry, and of various official and semi-official organizations. The Bureau of Fisheries has promised to detail experts to aid in instruction, and has already expressed the hope that trained men may soon be available from this course for the Federal service in the Bureau as investigators and engineers. They predict that the industry will absorb the greater number of men who receive this training, but that they can take a number of men yearly. The problem at the moment is to supply the men. The student looking for a new field of usefulness may well give this careful thought.

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G. E. STUDENT COURSE

(*Continued from Page 94*)

wiring up, he runs the tests called for and turns the results over to the Calculating Department. All of this is done, of course, under the supervision of the section head or his assistant, who are both college men specializing in that particular class of apparatus.

In my own case, I entered the Testing Course at Schenectady in 1913 and went through the following testing sections in the order named:

Motor generator sets below 500 KW.

Commercial transformer test and feeder voltage regulators (at Pittsfield).

Large motor generator sets and rotary converters (at Schenectady).

Direct current starting apparatus.

Railway motors.

Train control apparatus.

Induction motors and D. C. motors.

Commercial turbine test.

Special turbine test.

I know of no plan whereby a technical graduate can derive so much knowledge or development as by this course, since the problems are placed squarely up to every man and he must solve them to the best of his ability, always aided, of course, by experienced men

CHEMICAL EXPOSITION

(*Continued from Page 77*)

handles for pocket revolvers, baseball masks and numerous other articles where lightness is especially of advantage. Hard rubber piping, 8 inches in diameter, with a complete line of fittings was on exhibition.

But the most interesting marvel to be seen was a beautiful gold and blue "silk purse made from a sow's ear" in contradiction to the age old ultimate of impossibilities. Affidavits, sworn to by the workmen in a Chicago stockyard, that "100 pounds of ears cut entirely from sows" were forwarded to Arthur D. Little, Inc., settled the origin of the material. Four stages of the making were shown, the boiled down ears, the solution made therefrom, the silk spun from the solution and the finished dyed silk before it was woven.

The more technical exhibits included a chart of the numerous products of coal and coal tar. Various colored ribbons connected the substances in the proper order of their manufacture and, by their color, indicated whether the substance was a crude, an explosive constituent, a drug or a perfume. The exposition contained numerous charts and progressive exhibits showing in a similar manner the stages through which material passes to produce the many finished products. That of the New Jersey Zinc Company was probably the most fascinating in its completeness and novelty.

Good Equipment is Worthless Without Good Lubrication

THE efficiency of machinery can never be greater than the efficiency of its lubrication.

Lubricants which hurry equipment to the scrap pile—lubricants which require constant attention and application—lubricants whose continual dripping spells undue waste and fire risk are not efficient.

Cutting out waste and increasing output are the big problems of the present day. Proper lubrication solves both problems and

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INDUSTRIAL BUILDINGS SHOULD BE WELL LIGHTED.

From the employer's viewpoint, the big difference between men who work out of doors and those who perform tasks inside the building, is the factor of light. Daylight furnishes sufficient illumination outside during the daytime working hours for men to pursue their tasks efficiently and safely. But the proposition of getting enough daylight into the interior of industrial buildings, requires some thought.

It is not a difficult problem by any means, and any employer can take advantage of daylight and utilize it for lighting his building during the daytime, if he desires. It is an excellent light, especially suitable for the eyes, reducing eye strain and eye weariness to a minimum, and has the great economic advantage of costing nothing.

To utilize daylight to the utmost, we must first provide means for allowing daylight rays to enter the interior of buildings in sufficient quantity—namely, proper and adequate windows and skylights. Many excellent instances of buildings designed with a due regard to the importance of daylight lighting can now be seen in many of our industrial cities. Such buildings present the appearance of being practically all windows—"window walled," as they are termed—and this type of daylight construction is coming rapidly into favor, because it constitutes a more healthy building for large numbers of employes, both from the lighting and ventilation standpoints.

Among those who have constructed this type of modern industrial building may be mentioned: The Shredded Wheat Co., Gillette Safety Razor Co., Lyon & Healy Piano Co., H. J. Heinz Co., Corona Typewriter Co., Skinners Macaroni Co., Grape Juice Co., Dodge Bros., Nelson Valve Co., Piston Ring Co., Remington Arms Co., and a great many others.

The Larkin Co., Philadelphia, has erected a building almost entirely glass, 85% being windows, and the Loomis Breaker, operated by the D. L. & W. R. R. Co., Nanticoke, Pa., is literally a glass house, being 93.5% of glass. The new buildings of the Winchester Repeating Arms Co. have an average glass area of 58%.

An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 57.5%.

These figures indicate how important the subject of lighting is now considered by employers of industrial labor, and how well the idea has been carried out by the architects and engineers, in order that all parts of a building may receive sufficient daylight. But, in addition to providing ample window space, there is another factor which is equally important, and that is, equipping the windows with the proper glass.

The bright direct rays of the sun should not be permitted to strike the eye, and we must provide a means for reducing the glare to rays which will not be too bright. This is accomplished by glass especially manufactured for industrial windows, known as Factrolite. This glass possesses the property of breaking up the intense rays of the sun and diffusing the light into the interior of the building in proper portions, solving the problem of sun glare.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.

FIRE ALARM SERVICE

(*Continued from Page 92*)

or mechanism, as a result of contraction of the spring, which may be subjected to a temperature of say —30° F. after having been fully wound at a temperature of say 110° F.

From the foregoing it is apparent that good fire alarm engineering involves the recognition and correct solution of many intricate problems, and that there is probably no other branch of signaling, or public service of any kind, in which the requirements are so exacting.

Modern municipal fire alarm systems have, without a doubt, accomplished more than any other agency toward minimizing the average loss per fire in this country. On the other hand, such conditions as rapidly increasing congestion of population and property values into smaller and smaller areas, and the increasing exposure of fire alarm line conductors to lighting and power networks,—have served to render many methods and types of apparatus, which were tolerated under former conditions, unfit for present day use.

If not kept abreast with existing conditions, fire alarm systems which would otherwise serve to unmistakably and greatly decrease the losses from such fires as do occur, will become liable to serve, under the most distressing circumstances, to cause needless losses of lives and property. Such needless losses occur when an urgent alarm is delayed, or,—most tragic of all,—when defective transmission causes fire companies to go to a locality where their services are not needed, leaving an actual fire at a critical stage, and permitting such a fire to spread and perhaps exact a toll of lives, pending either the return of the falsely directed companies or the arrival of more distant companies subsequently summoned.

The responsibility for protecting persons and property from the fire hazard of our municipalities can be reasonably discharged only by increasing the effectiveness of fire alarm service. Needed effectiveness demands a greater density of street box distribution to keep pace with the increased density of the volume and value of combustible material, and forbids the use of any appliances or methods other than those which have been found to supply the needs of present day service.

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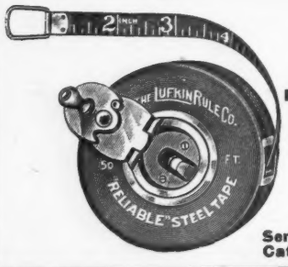

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The man whose courage and foresight gave alternating current to America, and founded the Westinghouse industries.

George Westinghouse

Thirty years ago the alternating current system was but an infant, for whose life those who believed in it were fighting daily and nightly battles; today this same system is a giant of almost inconceivable size, so capable of defending itself that no one seeks to attack it. For 95% of the electricity that is generated and transmitted today is alternating current.

The story of the development of alternating current is a story of courage and vision and faith; of misunderstanding and misrepresentation; of engineering failures and triumphs; of commercial ability and organization. It reads like a classic romance. In its chapters are credit and honor for all who have deserved it, but the central figure, the man whose motives and acts furnished the basis of the plot, was George Westinghouse, the founder of the Westinghouse Industries.

When, in 1886, he brought over from Europe the crude Gaulard and Gibbs system, even he, great as was his foresight, did not dream of the coming magnitude of the idea which he was fostering. The development work undertaken by the strong engineers whom he put to work led at first into many serious differences with those who favored direct current. Legislatures were even importuned to prevent the use of the "deadly Westinghouse Current," as many extremists described it.

That the little 50 horsepower generators of those days have grown to sizes two thousand times as large; that stations of a few horsepower have been succeeded by stations with a capacity of hundreds of thousands of horsepower, while at the same time, distribution voltages have grown from 1,000 to 220,000, is due largely to the vision and the courage of George Westinghouse, and to the qualities of the engineers whom he called, characteristically, to help him. By no means the least of the achievements of this man was his ability to organize the greatest aggregation of engineering intelligence ever known, men of analytical ability, consummate mathematicians, great inventors; and to promote in this great group the most harmonious and intelligent co-operation.

The same energy and courage and purpose that forced the acceptance of the air brake, the modern systems for the economic and safe distribution of natural gas, and later of the steam turbine, led and won the fight for alternating current, which has grown to be one of the world's greatest and most necessary commodities.

Westinghouse

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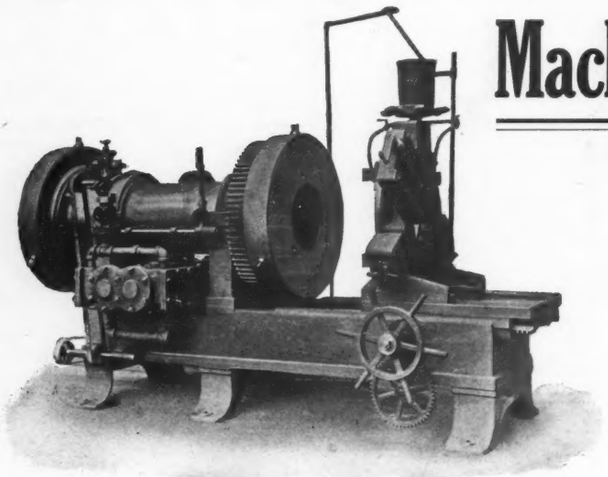

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77 Summer Street Boston, Mass.

BETTER LIGHTING

(*Continued from Page 83*)

solve, as to whether the sanitation of a factory which is lighted, ventilated, and air conditioned, by artificial methods, always under control and hence uniform, may not be superior to the present combination of natural and artificial conditions. Our swimming pools are made sanitary by artificial light rays, why not the air we breathe?

The problem of better lighting can be solved only by a more efficient type of lighting. Our most efficient lamps, such for instance as the gas-filled tungsten, radiate about one and a half candle power for each watt of power used. A perfect radiator of visible energy would give off about sixty-five candles per watt, so that it appears that our most perfect lamps utilize about two per cent of the total energy consumed, the remaining ninety-eight per cent is dissipated into heat. There seems little hope of any very great advance in illuminants which, like the tungsten lamp, produce light by purely thermal radiation. The temperature of the filament of a gas-filled lamp is so high that both practical and theoretical reasons indicate that only a small increase in efficiency may be hoped for.

The possibilities of such sources as the Cooper-Hewitt lamp, the Moore tube, and all those sources making use of the electric discharge through rarefied gas which are classed under luminous radiation (light without excessive heat) seem inviting. Physicists have an enormous field before them in the development of better knowledge of atoms and electrons and the mechanism of radiation, for luminous radiation seems very intimately tied up with atomic structure. With advances in light production must go advances in engineering. The engineer, realizing that ultimately the cost of light is dependent on the cost of energy, must see to it that our natural supply of energy is conserved, that its distribution shall not be wasteful, that the light which is economically produced shall be utilized to the greatest advantage, i. e., shall fall in the right place, on the work and not in the eye, shall be right in amount and color and direction.

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Detailed information on bearing design and installation is contained in our pamphlets: Lubrication of Ball Bearings, Limits and Allowances on Shafts and Housings; Calculating Bearing Loads; Interchangeable Sizes of Strom Bearings.

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To be admitted to the Institute, the applicant must have attained the age of seventeen years and must pass examinations in Algebra, Plane and Solid Geometry, Physics, Trigonometry, English, French or German. Certificate of preparation in two units of a series of elective subjects is also required. The requirement in History may be met by the presentation of a school record of certificate grade. A division of these examinations between different examination periods is allowed. In general a faithful student who has passed creditably through a good high school, having two years' study of French and German or three years of French or German should be able to pass the Institute examinations.

Graduates of colleges, and in general all applicants presenting certificates representing work done at other colleges, are excused from the usual entrance examinations and from any subjects already satisfactorily completed. Records of the College Entrance Examination Board, which holds examinations at many points throughout the country and in Europe, are also accepted for admission to the Institute.

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The tuition fee, not including breakage in the laboratories, is $300 a year.

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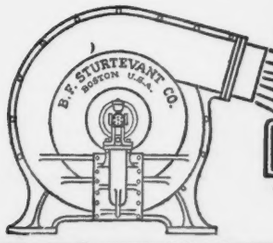

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